MAY 16 1921

May 12, 1921

Engineering News-Record

Devoted to Civil Engineering and Contracting. McGraw-Hill Company, Inc.

A New Group of Articles for the "Average Engineer"

TWO issues of the *Engineering News-Record* last year carried groups of articles for the "Average Engineer"—none of them dealing with large costly works, but all with smaller undertakings encountered by engineers in ordinary daily practice in the field and in the office. The editors have selected the present group in response to the approval of many readers following previous "Average Engineer Issues."

Also in This Issue:

An Analysis of the Current Kansas City Southern Valuation Report
By Samuel W. Moore
General Counsel, The Kansas City Southern Ry. Co.

Economics of Highway Improvement
By H. G. McGee

Final Report on Waste Disposal of Chicago Stockyards

KREOLITE LUG WOOD BLOCKS

"Outlast the Bridge"

Kreolite Lug Wood Blocks in Cuba

The engineers on the Miramar Bridge over the Almendares River, Havana, Cuba recognized the better value and the better service represented by Kreolite Lug Wood Blocks.

The flexibility of the blocks under expansion, when laid with an open joint Kreolite Lug construction, prevents the possibility of buckling, the wedge-shaped lugs compressing when the blocks expand.

The lugs permit the bituminous filler to penetrate the full depth of the blocks on all sides, thus making a water and wear proof surface.

The compression of the lugs under expansion also retards bleeding.

The lugs afford a foothold for horses and automobiles equipped with tire-chains.

Our Engineering Department will gladly furnish detailed specifications, sketches or estimates for any of your bridge floors or street pavements.

The Snare & Triest Company of New York were the engineers on this bridge.

The Jennison-Wright Company, 79 Kreolite Building, Toledo, Ohio

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

Volume 86 — NEW YORK, THURSDAY, MAY 12, 1921 — Number 19

Average Engineering

JOURNEYMAN engineering is the skeleton of the profession; without it the body would be flabby and useless. Day by day every engineering office is confronted with little problems insignificant in themselves, perhaps, but time wasting in the aggregate, particularly if the methods of attack are wrong or clumsy. To the solution of those problems the journeyman engineer must bring the essentials of his knowledge and skill. The art and science of engineering progresses more steadily by the improvements in those solutions than in the successful completion of monumental projects. To emphasize somewhat the importance of such routine work, *Engineering News-Record* has again gathered together in this issue a few of these average engineering problems. In themselves these articles are not spectacular; in the aggregate they and their like are the essence of engineering literature.

Looking Ahead on Transit Problems

ONE of the commendable features of the reorganization of the Transit Commission in New York City is the provision for advance planning of facilities to cope with the demands of the future. This phase of the work has never been given the importance it deserves and the work of the former commissions has been so organized as to tie the city's engineers largely to work actually in hand. Neither the time nor the personnel was available for the type of intensive study of future needs which was recognized as highly desirable. This condition has been remedied by a readjustment of the duties of the commission's top-ranking engineers. D. L. Turner, formerly chief engineer, assumes the title of consulting engineer and will devote his entire time to plans for the future. Robert Ridgway, appointed chief engineer, will concern himself solely with the present program of design and construction. Both engineers bring to their new duties a long and intimate experience with New York's transit problems. The new division of responsibilities promises to assure to the city an intelligent handling not only of present work but of broad plans for the future.

Estimates and Bids

NUMEROUS cases have been reported recently in which highway bids are far below engineers' estimates. In last week's *Engineering News-Record*, for instance, were given details of a recent letting in Arizona, in which it was shown that the successful bidder, one of eleven bidding, was about 35 per cent under the engineer's estimate. Such a condition demonstrates that there is keen competition among contractors to secure available work. Might it not also indicate that engineers, long used to erratic and high prices of materials and labor, are failing to take full advantage of recent reductions! Again, it is true that labor has increased its efficiency considerably within the past few months, due to the weeding out of the less competent and the competition for places, a condition which the contractor who knows the ability of his men is able to take full advantage of, and one which the engineer only with difficulty can estimate. However, since high estimates are incentives to high bids, it is essential that engineers keep a close watch on prices and make a thorough analysis of conditions in order to know as closely as possible what work ought to cost. Just now, competition is bringing prices down. Possibly that element may be lacking when the competent contractors have taken on their season's quota. Then the engineer's knowledge of the situation may be a more important factor in letting work at proper prices.

Summary Dismissal of Engineers

A PECULIAR situation obtains with reference to the summary dismissal last week of the entire board of consulting engineers for the Hudson River vehicular tunnel by the New Jersey section of the joint tunnel commission. Under the laws the New Jersey and the New York commission each has a separate existence, but they function jointly. The consulting engineers were engaged by the joint body. Now one of the constituent commissions, because the joint body would not agree to widening of some of the streets in the vicinity of the Jersey City entrance of the tunnel, has summarily dismissed the consultants. Without hearing, they have charged that the board of consulting engineers has failed "to give full and proper consideration to the plan as a whole and to the traffic conditions in the vicinity of the Jersey City entrance and exit." If the joint commission had taken similar action there would be some reason for detailed inquiry as to the work of the consulting board. The action being taken by only one constituent of the joint body, however, and that at a time when Jersey City politics may demand some fireworks preceding a nearby election, puts it rather in the category of a politician's cheap dealing with a serious matter. To show how shallow the thinking of the Jersey commission is it need only be set down that the commission now recommends the appointment of two independent consulting boards, one by the New Jersey and one by the New York commission. This is nothing more than a scheme for intensifying partisanship. If the two states propose to build a vehicular route under the river it will only be accomplished satisfactorily—if at all—by both bodies acting as one and in complete harmony. Some power is needed which will take the parties at outs, sit them down around one table, and keep them there until they all go out of the room a unit with reference to conducting the enterprise. Political and petty tampering with an engineering enterprise of such magnitude may not end in disaster, but it will inevitably lead to a waste of the people's money. Evidently the Jersey commission does not want disinterested engineers to advise it, but rather a group subservient to petty local interests.

New York Licensing Controversy

THE Governor of New York has signed the bill which permits corporations and unrestricted partnerships to practice engineering, with the proviso that those in charge of the engineering work must be licensed engineers. The new law, therefore, is substantially the same as its predecessor, the amendments merely clarifying the existing statute. Temporarily, at least, the controversy is settled in New York State. But the matter is not a dead issue. American Engineering Council has referred it to the original licensing committee for study and report. Both sides will doubtless be examined at length—which is as it should be. The issue is a fundamental one. Engineering must decide whether it is a business or a profession.

Twelve-Hour Day to Go

SIMULTANEOUSLY with the annoucement of a wage reduction, the steel corporation reiterates the position which it made plain in its annual report some weeks ago regarding the 12-hour day. In brief, the 12-hour day and the seven-day week are to go. It is time, all will agree, that they should. Tradition has probably been largely responsible for keeping them so long, though fundamental difficulties in the industry had an important bearing on causing their retention so long. The complete elimination of the 12-hour day is not possible at once, but the corporation pledges itself to its elimination as rapidly as possible. Just to whom credit for this decision is to be given, we are not in a position to say. The labor unions have long agitated against the 12-hour day, but we want to call attention to the very intelligent studies of the subject that have been made recently by engineering specialists in industrial plant operation. Without having full knowledge of the process of reasoning which prevailed in the steel corporation, we are nevertheless quite inclined to believe that the studies made by these industrial specialists had decidedly more weight in bringing the corporation to its conclusion than that of all of the agitation of labor leaders indulging solely in generalities. Without a doubt the steel corporation's own experienced operators went into the subject and checked the results which industrial engineers claimed for shorter-shift operation in other steel mills.

Reduction in Steel Wages

LAST week's announcement of the reduction in wages of the day workers in the plants of the United States Steel Corporation is the second of two recent important developments in the general adjustment of the wage situation. The first was the determination by the War Labor Board that the national working agreements should terminate next July. While no right-minded man enjoys seeing the income of his fellow men reduced, we are simply accomplishing now from day to day the adjustments that inevitably flow from the inflated period of the war. Adjustments upward were accomplished easily. The reverse movement is beset with greater difficulties. Surely, however, the steel corporation has set all industries a good example in deferring the wage reduction as long as possible and until the period when the reduction in the cost of living has, by a safe margin, preceded the wage reduction time. In doing this they set just the same good example that they did when, in the period from 1915 to 1920, inclusive, they increased wages at nine different times and without a strike (for the strike in the steel industry was not for an increase in pay); raised the wages from $2 to $5.06 for a 10-hour day. Now the wage will go back to $4.05 for 10 hours. It must be remembered that the plants of the corporation are operating on only about a 40 per cent basis, and that as a result one would not hear much adverse reaction on the wage reduction. Nevertheless, the almost total absence of any adverse inflammatory comment indicates that the workers see the fundamental economic necessity for the adjustment.

Fenced City Streets?

KILLINGS in city streets by motor traffic have increased in horrifying degree in the last few years. The truck is the chief instrument of evil in this regard. It kills more than one in ten thousand people each year, and little children are the victims in the great majority of cases. The gruesome record demonstrates conclusively that the use of streets as playgrounds is incompatible with their use as roadbeds for high-speed truck traffic, and vice versa. But trucks are increasing in number, and their importance in city life is increasing perhaps even more rapidly. Since children are not decreasing in number, no end to the continuous street fatalities is in sight; on the contrary, further increase may be expected. Attempts at police control of either trucks or children have not reached the basic trouble—the competitive use of the streets. In the modern business street we have, in fact, a roadbed of dense, high-speed traffic, closely analogous to the railroad right-of-way, and it is quite unlikely that police control will be more effective in the one case than in the other. Long experience has shown that railway roadbed is unsafe for trespassers except when trespassers are kept off; the fenced right-of-way has been found to be a necessity. In a few special localities we have already come to the point of classing pedestrians as trespassers on streets. Are we to go further and ultimately convert the street into a fenced roadbed, with the buildings and sidewalks cut off from it by barriers? It seems a strange prospect, and a city of such streets would be a strange city. Were it possible to carry out zoning so thoroughly as to put children in certain of the streets of a city and trucks in another, the problem would be solved in an easier manner. But such a solution implies traffic zoning, something rarely attempted. It has promising possibilities; but it would give the entire zoning movement a different aspect. Obviously, the point has no force in the suburbs where there is ample ground around detached homes for playground, but it has force in congested districts.

Method of Valuation Not Yet Fixed

FINAL METHODS to be pursued by the Interstate Commerce Commission in fixing the value of the railroads of the United States have yet to be formulated and announced by the commission as a whole, regardless of the fact that a division of the commission has given single sums as property values for four companies, at the same time reporting additional costs of acquiring carrier lands, as it was required to do by the decision of the Supreme Court in the Kansas City Southern case. An analysis of the more important points at issue, suggested by the recent "supplemental" reports, appears on p. 818, in an article by Judge Moore of the Kansas City Southern. Some have termed it futile to attempt

valuation on such a large scale for a number of purposes, but the importance of the subject can hardly be overemphasized since the laws requiring that the work be done are on the statute books. Moreover, the Valuation Act itself requires that values finally found shall be considered *prima facie* evidence in future proceedings before the commission. Now that field work by the commission's and the carriers' engineers is almost completed, the work of the engineers will be largely in working out accounting methods. Therefore, an authoritative statement regarding methods and purposes is of great importance to valuation engineers.

Evidently, only two or three members of the entire commission of eleven are committed to tentative valuation reports so far issued and the methods employed. The issuance of the most recent report on April 5 was occasioned by the decision in the Kansas City Southern case requiring the commission to find and report separately the additional cost of acquiring carrier lands due to severance damages, condemnation proceedings, etc. In the meantime, although the Valuation Act and the Interstate Commerce Act do not make the point specifically clear, it had been decided by the commission that it had authority to fix single sums as value, instead of reporting only cost of reproduction, depreciation, original cost, and "other elements of value." So the next step was to issue "supplemental" reports, including single sums as final value and at the same time comply with the Supreme Court decision.

Under these circumstances, it is regrettable, as Judge Moore says, that Division 1 of the Interstate Commerce Commission has not seen fit at this time to announce the method pursued in arriving at the single sums given. However, we have no doubt that the engineers of the commission and the commission as a whole will have such faith in finally adopted methods that there will be no reluctance whatever in defining and announcing them.

It is pointed out by Judge Moore that the formula for determining final value recommended by the director of the Bureau of Valuation has probably been used in determining the single sums now given. If it is a fact that such a method has been used to the exclusion of the additional costs of acquiring carrier lands, the action taken does not appear to comply with the spirit of the decision in the Kansas City Southern case. Commenting editorially, following the decision in the Minnesota rate cases, this journal recognized that the cost of acquiring railroad land is obviously a great deal higher than is the normal value of adjoining land. While the Supreme Court decision only required the Interstate Commerce Commission to find and report the additional costs of acquisition, the spirit of the decision would certainly seem to be that consideration should be given such costs in any attempt to fix single sums as "value."

Progress has been made, but final methods have not been evolved. The commission must face the question whether it shall find different "values" for different purposes, such as would be used for condemnation proceedings in the consolidation of railroad properties under the Transportation Act, or for use as a rate base. Decision may be made to fix only one value for all purposes. As pointed out by Judge Moore, "the real problem before the commission is to decide what kind of value it is to find, and how it shall be determined, and its solution of this problem remains incomplete."

Getting Together on Federal Highway Policy

A VERY material step forward in composing the differences which exist regarding a proper federal highway policy has been made through the new bill which Senator Townsend has introduced. It accepts the federal-aid principle, in lieu of the policy the Senator has previously fathered of the construction of a national highway system at the exclusive cost of the federal government.

This is a fortunate step, for it places the former national highway system advocates in harmony with the state officials whose influence in the past has been strong enough to have large appropriations voted by Congress on the fifty-fifty basis. Now that the critical issue of the basis on which the federal funds should be spent has been settled, there should be a possibility of getting together on the great remaining matter of difference—the method of administering the government's highway activities.

Senator Townsend's new bill, like those that he has introduced in the past, calls for a Federal Highway Commission. The bill fathered by the state highway officials would leave the administration in the hands of the Bureau of Public Roads. Those acquainted with the government's participation in highway activities know very well that the original purpose in advocating a Federal Highway Commission was none other than to inject vigorous action into the government's highway work. Three years ago there was widespread dissatisfaction with this feature of federal administration, and the commission was proposed and ardently advocated chiefly by those who believed it a means of replacing the inaction with a vigorous policy. In the last two years, however, there has been a material change for the better, and highway officials throughout the country are thoroughly satisfied with the way the government highway activities have been administered.

The main reason, therefore, for which the commission was at first advocated is now removed. Moreover, there is growing up today in governmental circles a strong opposition to all of the "independent establishments," except those having judicial functions. In many quarters in Washington there is strong conviction that all of these independent establishments should be thrown into appropriate departments wherever administrative functions are involved.

Advocacy of the formation of a Federal Highway Commission at the present time, therefore, not only lacks the backing which circumstances gave to the proposal originally, but must meet with the strongly developed opposition to commissions and other establishments outside of the departments and reporting directly to the President. Regarding the undesirable features of these independent establishments we are sure to hear more when hearings get under way before Senator Smoot's committee, which is to study the reorganization of the government. It will then become plain, we believe, that it is hopeless now to expect Congress to authorize any new independent establishments, such as the Federal Highway Commission would be.

With the situation as it is, we have high hopes that Senator Townsend will abandon this feature of his proposed law. Should he do that there will then be entire agreement between the former opposing federal-aid and national-highway camps, and that in turn would assure an uninterrupted continuance of liberal federal support for highway development.

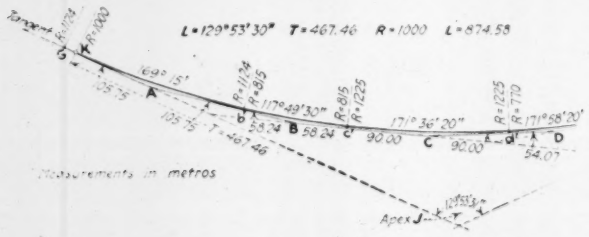
A Group of Articles for the "Average Engineer"

Resurfacing Pavements—Stray Points in Structural Design—Property Monuments—A Railroad Resurvey—Continuous Beams—Layout of Stairways—Reinforced-Concrete Chimney Design—Determining Turbine Speeds—Combined Methods in Surveying

Simple Method of Resurvey for Line Adjustment

By Peter Vassallo
Engineer, Way and Works, Egyptian State Rys., Cairo, Egypt

Necessity for line adjustment on the Egyptian State Rys. in 1920 led to preliminary resurveys being run by methods somewhat different than the curve intersection method described by J. G. Wetherell, assistant engineer, Chicago, Milwaukee & St. Paul Ry., in *Engineering News-Record*, March 18, 1920, p. 575. It was necessary to adopt a method that would accomplish the purpose with only laborers in the party in addition to one engineer. Instead of intersecting and traversing curves, I found it most expedient to locate them by running a series of tangents.



CURVE RESURVEYED BY TANGENT METHOD

The method employed is illustrated above, tangent lines intersecting at *A*, *B*, *C*, *D*, etc., starting at the point *G* of the tangent and laying off an arbitrary distance to the point *A*, where the transit is set up on the embankment outside of the curve. The point *b'* is located by sighting on the line of curvature as the point of tangency, which is marked. While the laborers are chaining the distance *Ab'*, the engineer is measuring the angle *GAB*. The line *Ab'* is again extended to a point *B* and the point *c'* is located by the same method as *b'*, and with the distance *b'B* and *Bc'* equal as tangent distances. Thus the entire curve is located with points *b'*, *c'*, *d'*, etc., as common tangent points—or as points of compound curvature. In the case of compound curves it may be recognized that the method is approximate, but it was found to serve the purpose.

With tangent lengths and corresponding angles recorded, the radius of each portion of the curve is readily calculated. If it is found that the radii closely correspond they are averaged to obtain the radius of simple curve desired to re-run for readjustment of the line. Points of compound curvature and the radii of compound curves may also be so determined.

From this determination the curves can be re-run and pegged out if rail and ties are to remain, but if general hauling is required or heavier track is necessary in adopting heavier rolling stock, pieces of rail are driven ½ m. deep with points accurately marked on the top exactly 2 m. from each peg point.

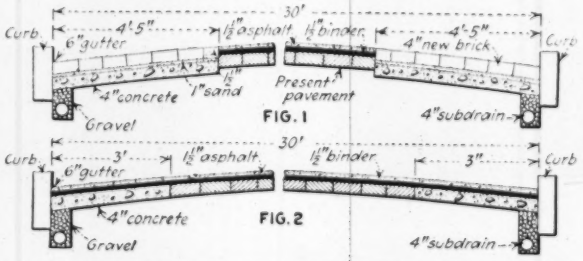
The resurvey of the line was executed by one party consisting only of one surveyor with some laborers, commonly called chainmen here in Egypt. The work was conducted in the hottest part of the year and it started exactly with the Mohammedan fasting month—Ramadan—and few foreigners know what this means. Finally the engineer produced the drawings necessary for office use.

Resurfacing of Brick and Cobble City Pavements

By W. H. Eagle
Assistant Engineer, Columbus, Ohio

Thirty-two years ago three old cobble stone streets in Columbus, Ohio, were resurfaced with asphalt. After twenty-three years of traffic had demonstrated the success of the resurfacing operation, Columbus adopted it as standard practice in restoring worn out brick and stone block pavements. To date more than 145,000 square yards of old highways have been given new asphaltic wearing surfaces.

One of the streets repaved in 1888 was Bryden Road from Parson Ave. to 22nd St. This street still is in excellent condition and the indications are it will last several years longer with reasonable cost for maintenance. The maintenance cost during the life of this pavement, laid with Trinidad asphalt, has been $0.021 per sq.yd. per year. The other two streets resurfaced in 1888 still are in use although the maintenance cost



SECTIONS SHOW RESURFACING METHODS TO AVOID SHALLOW GUTTERS

has reached a point where they should be repaved. Washington Ave., from Broad St. to Town St., was resurfaced with native lake asphalt over cobble stones in 1901. This street is in excellent condition today. It has had no repairs, nor has it disintegrated, shoved or cracked. While these streets are in residential sections they are subjected to fairly heavy traffic.

The City of Columbus has a large mileage of brick and stone block streets that are from twenty to thirty-three years old. These pavements were laid on a gravel, a broken stone or creosoted plank and sand foundation. The bricks were small sized with the joints filled with either sand or tar. The gravel or broken stone foundation is about eight inches deep, with from one to two inches of sand cushion. In 1912 the City began to

resurface these brick and stone streets. Briefly, the methods used are as follows:

All depressions over three inches deep are filled with cement concrete, slight depressions being taken care of with binder. The street is then thoroughly cleaned either by flushing with a fire hose or by raking out the joints with sharp picks or hooks and hand sweeping. It is essential that the street be thoroughly cleaned, and all joints cleaned to a depth of at least ½ in. All manhole covers and street boxes must be raised to conform to the grade of the new pavement and the pavement adjusted at all paved intersections.

A closed binder 1½ in. thick, containing 20 to 30 per cent of mesh material, then is laid directly on the old pavement. When there is considerable variation in depth due to the irregular contour of the old pavement the binder is laid in two layers. It is figured that 1 cu.yd. of binder box measurement will lay 20 sq.yd. 1½ in. deep. All binder used in excess to this is paid for at price bid. This excess binder has amounted to about 2 cu.yd. per 100 sq.yd. of surface laid.

STREET RESURFACED AND GUTTER RENEWED

Upon the finished binder is laid a standard sheet asphalt surface 1½ in. in depth. Generally the department prefers to resurface an old brick street from curb to curb. As the depth of gutters in Columbus is six inches, this results in a very shallow gutter when the street is resurfaced, which is unsightly and, where grade is flat, may result in flooding the sidewalk during heavy storms.

To avoid this shallow gutter, one of two things may be done. First: a strip of the old brick, 3 or 4 feet wide, as in Fig. 1, may be taken up along the curbs and a new brick gutter constructed upon a concrete foundation, to such a grade that there will be a shoulder at the outer edge, sufficient to take care of the asphalt pavement and be 5 or 6 in. below the top of the curb at the inner edge to form the gutter.

Second: a strip of brick may be taken up along the curbs, as in Fig. 2, and replaced with concrete to such a grade that asphalt may be laid from curb to curb and still maintain a proper depth of gutter. This method is particularly advantageous where the old pavement has not sufficient crown.

By resurfacing the city saves about 25 per cent over the cost of a new pavement with a concrete foundation. In my opinion these streets have given equally as good service as streets with similar traffic conditions, where new concrete foundations were used.

All streets resurfaced since 1912 are in good condition and have had no repairs except slight repairs made by the contractor under his guarantee. These were practically all settlements over trenches or openings made in the old pavements prior to their resurface. The resurfaced streets are particularly free from cracks and shoves.

Diagram for Effect of Flange Holes in Beams and Channels

By Henry Kercher
King Bridge Co., Cleveland

THE excellent articles by R. Fleming, under the title "Stray Points in Structural Steel Design," which appeared in *Engineering News-Record* of May 27 and June 3, 1920, pp. 1040 and 1104, cover some of the vital points often overlooked by the designer. In the first of the two articles appears a paragraph devoted to the weakening effect of flange holes in beams, which is accompanied by a table of the reduction in section moduli of the different minimum-weight standard beams and channels for the various combinations of holes out of the flanges. The author also gives two diagrams showing the bending moments for beams carrying a uniformly distributed load and a load concentrated at the center of the span. By means of the table of reduction in section moduli and the moment diagrams, the designer can estimate approximately at what point it is safe to take out the number of holes desired. This paragraph gave the writer the idea from which he has prepared the accompanying chart.

Minimum-weight standard sections were used, as in Mr. Fleming's article, as were the maximum rivet diameters allowable, these being identical with those given in the Carnegie "Pocket Companion." The holes were taken as ⅛ in. greater in diameter than the nominal diameter of the rivets, as is customary. The thickness of the metal on the gage line was taken equal to that for a beam or channel next greater in weight than the minimum section; this produces a very slight error on the safe side for the minimum section, and reduces the error where the chart is used for the heavier ones.

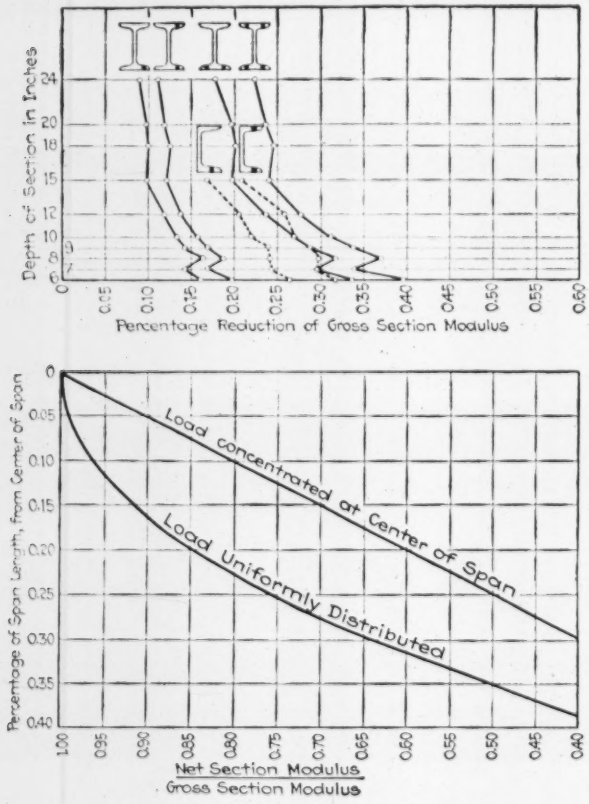
Comparison of the percentage reductions of the section moduli given in Mr. Fleming's table with those shown on the chart will disclose variations as great as 2 per cent in some cases. The writer made two independent calculations for each case as a check on his results. The thickness of the metal on gage line was calculated decimally from the profile of each section. The above-mentioned variation may be due to Mr. Fleming's using the grips of the rivets in common fractions, as they are given in the various handbooks.

It may also be mentioned that a hole in the compression flange filled with a bolt should be treated the same as a hole out of the tension flange. This is a point often overlooked by designers.

While the chart will be found to be simple and self-

explanatory, an example will be given to illustrate the use of it.

Suppose we have a 15-in. I-beam of 42.9 lb. per ft., spanning 25 ft., with sufficient lateral support, carrying a uniformly distributed load of 25,000 lb. This load will produce an extreme fiber stress of 16,000 lb. per square inch at the center of the span, if no holes have been taken out of the flanges. Suppose it is desired to take one hole out of the tension flange at a distance of 5 ft. from the center of the span. The problem is to determine whether the net section modulus at this point



WEAKENING EFFECT OF FLANGE HOLES

is sufficient so that the extreme fiber stress will not exceed 16,000. Follow the curve on the chart under the sketch indicating one hole out of one flange of an I-beam until it intersects the horizontal line indicating a beam 15 in. in depth. Then follow vertically downward to the curve marked "Load Uniformly Distributed." Then trace horizontally to the left, noting the distance from the center of the span to the point where the hole can be removed. This is 0.16 of the span length, and as $0.16 \times 25.0 = 4$ ft. the proposed hole at 5 ft. is allowable. Similarly, two holes may be taken out of one flange at a distance of $0.23 \times 25.0 = 5.75$ ft. from the center of the span. The other cases for the uniformly distributed load, as well as those for the concentrated load, are worked out in the same way.

To calculate the net section modulus of a beam heavier than the net section, subtract the product of gross section modulus of minimum section by percentage reduction from the gross section modulus of the beam in question. For example, the net section modulus of a 15-in. 50-lb. I-beam with one hole out of one flange is 64.5 less $58.9 \times 0.097 = 64.5 - 5.7 = 58.8$. The percentage reduction of the gross section modulus = $5.7/64.5 = 0.088$. Beginning at the top of the chart with this value and proceeding as before, it is found that one hole may be taken out of one flange at a distance of (0.15 × span length) from the center of the span for a uniformly distributed load.

This diagram should prove of as much use to the detailer as the designer, as often it is the detailer rather than the designer who must solve this problem.

A Group of Articles fo

Bunk-Houses Built in Sections for Convenience in Moving

By R. M. Adams
Civil Engineer, Montrose, Colo.

A SUITABLE substitute for the canvas tent as sleeping and eating quarters for the workmen on the Twin Falls Irrigation Project recently became a necessity, and I drew the design shown in the accompanying drawing on that account. Before this was adopted discussion of the requirements resulted in the following specifications which the bunk-house would be required to fill: (1) The weight of two houses must not exceed the capacity of a 2-ton truck; (2) some of the sections of the buildings must be made of such dimensions that they would go into and snugly fill the body-box of such a truck so as to make a complete and stable load when the two houses were placed on it; (3) the floor plan of the house must be about 14 x 16 ft.; (4) the roof must be storm proof without the use of tarpaper roofing; (5) the house must be designed so that two or more could be joined end-on to form a longer building; (6) no section could exceed the weight or bulk that could be easily handled by three workmen; (7) the house must be so built as to outlast a tent in the ratio of at least three to one.

With these requirements laid down there was but little choice left as to design, but there was considerable latitude in the matter of devising means of increasing the speed and the ease with which the building could be put up or taken down and loaded. Experience with about a dozen of these houses during a very severe winter has shown them to be very satisfactory shelter, and they have been adopted as standard on this work.

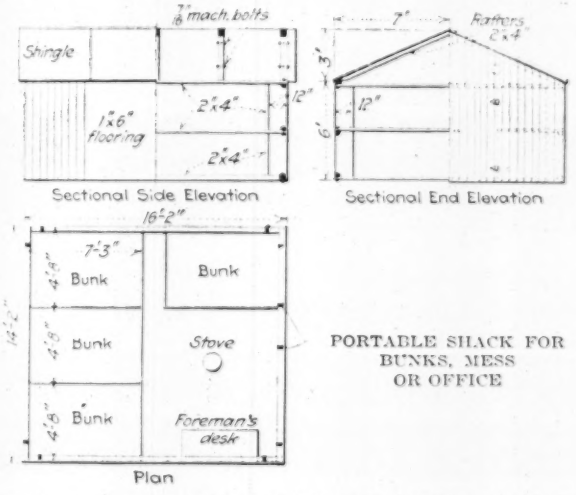
The largest piece to be handled is a side. The roof is handled in eight sections, four pieces to each side of it. Where two sections of the roof meet, the joint is made tight by fitting a U-shaped piece of metal over the upturned metal strips which the shingles cover, partly, at each edge of the piece. These strips are made of 20-gage material because any sheet iron that could be used would get bent and the light weight can be bent back to place with the fingers.

A feature of primary importance in setting up the building is that the periphery of the plan be in a plane that is level; the ground must be leveled. Unless this is done, the roof sections will not fit together snugly, and it will be difficult to make the building storm proof.

Corners that go together in the assembled structure are lettered with the house number, the number of the corner, and the piece number, so that in loading, unloading and assembling there need be no mixup to delay the process of moving camp. Black paint is used for this numbering and also for painting the house number on the two ends of each building.

the "Average Engineer"

An experienced gang of camp movers—four men—were able to put up one of these buildings singly in an hour, including the frame for the bunks and the placing of a small stove. When two houses are placed together, by sacrificing two boards on the sides at each end of the two placed together, a window may be put in at the joint without any waste of material should it later be desired to use the two buildings as single units. Windows are provided for each house, but the window hole is not cut in the end opposite the door until the house is set up the first time. This window is simply marked out and left to be cut when erected. In this way, if a new building is used for a part of a long building, the stiffest portion of the structure does not warp during the time it lays in stock pile awaiting the time it will be used as a single unit. The stiffness of the end pieces for handling is much increased by this procedure. This idea of retaining parts in stock is based on the plan of having all parts interchangeable. However,



PORTABLE SHACK FOR BUNKS, MESS OR OFFICE

so long as a part of a building is intact and fit to repair, it is assumed that it will remain in the structure for which it was built.

BILL OF MATERIAL

LUMBER

10 bunches cedar shingles	250 lb.
9 pieces 2x4—18 ft. for rafters and studs....108 ft. b.m.	
7 pieces 2x4—16 ft. for plates, rails, sills.... 74⅔ ft. b.m.	
8 pieces 2x4—14 ft. for plates, rails and ties. 74⅔ ft. b.m.	
3 pieces 1x6—16 ft. for ridge finish..... 24 ft. b.m.	
20 pieces 1x8—16 ft. for roof sheeting.....213⅓ ft. b.m.	
Total 495 ft. b.m., or approx	1,550 lb.

HARDWARE

8 pieces ⅞ in. x 6 in. machine bolts	2.6 lb.
24 pieces ⅞ in. x 6 in. machine bolts	5.7 lb.
32 pieces ½ in. flat washers	0.7 lb.
32 pieces ½ in. threaded nuts	2.0 lb.
1 pair 6 in. T-hinges	1.5 lb.
1 Rimlock with knobs	2.0 lb.
16 d. nails	90.0 lb.
20 d. nails	5.0 lb.
4 d. nails	5.0 lb.
Twenty-gage galvanized iron roof tin	12.0 lb.
White lead paint for one heavy coat	18.0 lb.
Total hardware, nearest pound	145.0 lb.
Grand total for the building	1,695.0 lb

The siding is made to extend slightly beyond the plates, so that the ends of the rafters drop down with scant clearance just inside the siding, when they fit up snugly at the peak. No bolts are used to hold the roof sections down; its weight is sufficient for this purpose. Neither are nails driven to hold any of the sections together, although four nails are used on each ridgepole board after the roof sections are in place.

When this kind of structure is made in lots of six or more buildings at a time the cost is $125 each exclusive of bunks. All subject to 1919 prices.

The life of such a building, which is lengthened by painting the entire outside except the roof shingles, and allowing for 12 moves, is about six years.

Combined Methods Useful in Topographical Surveying

BY P. J. BARRY,
Dominion Water Power Branch, Department of the Interior, Canada, Winnipeg, Manitoba

TOPOGRAPHICAL surveying is frequently enlivened by discussion of the comparative merits of the instruments used—transit, plane table or chain. Experienced topographers, however, see little reason for argument because a country which may be suitable for one instrument will often prove entirely unsuitable for another. The surveyor who does not confine himself to one particular method will produce the best work.

The transit theodolite may be considered as indispensable for laying out the triangulation, or the control lines, of a topographical survey but when that is done it may profitably be laid aside. Experience has shown that the plane table and chain are better adapted for the detail work. The transit and stadia method applied to the intricacies of town or city topography is very tedious and the accumulation of field notes is a fruitful source of error in plotting. Except in isolated cases, the general use of the transit for detail work cannot be recommended as economical.

The plane table, when used for supplying topographic detail, has many advantages over the transit. In conjunction with stadia it gives excellent results but it is by no means limited to this operation: in the hands of a competent topographer, very good work can be done on the traverse "table" without the aid of transit, stadia or tape. More freedom of movement is allowed by its use and many problems requiring quick solution are not possible by other methods. The plane-tabler has the additional advantage of being his own draughtsman and can give a natural finish to the map which is not possible in the office.

The "triangle and chain" method of surveying has not been used to any extent in the United States or Canada, probably due to the system of laying out land divisions in these countries. In parts of England, however, it is the only solution for the irregular and congested details which exist there. The British Ordnance Survey maps are very accurate although the field work was done rapidly. The triangle and chain principle upon which these maps are based is perhaps the simplest yet most efficient method of detail surveying known. A glance at Fig. 1A will show the firmness with which a block (shaded) can be held in position by tied lines inside a triangle.

The following three examples are typical of what a topographer is likely to encounter in the field from time to time. They show the necessity for being acquainted with two or more methods of surveying, if reasonable progress is expected.

Problem 1—In Fig. 1, the point *A* was the extremity

of a chained traverse; it was required to locate three points across the bay at *B*, *C*, *D*, without cutting bush. No set-up was possible off the line *ABCD* and no part of this line could be chained. Points could be given to the rodman (by signal) in the low bush shown inside the dotted line. The plane table was laid aside and the transit set up at *A* and sighted to *D*. An angle of

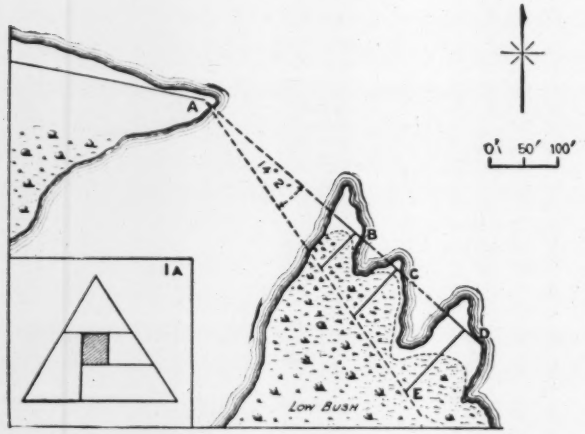


FIG. 1. TRANSIT METHOD LOCATES ISOLATED POINTS

14° — 2′ was turned to the right and sufficient points given to the rodman to establish a line in direction of *E*. Crossing over, the instrument was set up at *B*, *C*, and *D* in turn and a right angle turned off from the line *AD* at each set up. The right angle lines were intersected on the line *AE* by means of the points given to the rodman and their lengths chained. This operation formed three right-angle triangles. An angle of 14° — 2′ at the extremities of the base and hypotenuse of a right-angle triangle gives a ratio of base to perpendicular of 4 to 1. Therefore, the chained right angle lines from *B*, *C* and *D* (being in this case the perpendiculars), were multiplied by 4 to obtain the lengths of the bases, or *AB*, *AC*, *AD*, which were the distances required.

Problem 2—The problem represented by Fig. 2 is the reverse of that in Fig. 1, and the transit had to be discarded in favor of the plane table for lack of time. It was required to find the exact map location of the gun position at *B*. The only ground on which the plane table could be set up was along the narrow strip screened by the small wood, and extending for about a hundred yards north and south of G^1 and G^2. It was not possible to see through the wood and the instrument could not be set up in it, but a man could crawl through to the east edge unseen by the enemy observers. Chaining the distance was out of the question.

Before setting up the plane table the topographer proceeded to lay out two lines for intersection. Going around by way of a communication trench he placed a slender stick about 8 ft. high at the gun position *B*. Returning to his first position near G^1 he crawled carefully through the wood in front until he could see the top of the stick at *B*. This was his first point, *A*. From this point he observed an object in line with, and beyond *B*, say at *C*. Placing a small piece of paper on a stick at *A*, he retired until his object at *B* was about to disappear. Then he placed a second stick and paper at

A Group of Articles for

D in line with *A*, *B*, *C*. Backing carefully and keeping two objects in view all the time he put pickets in at *F* and G^1. Estimating by eye a serviceable base, he entered the wood again near G^2 and brought a second line out at G^2. Setting up the plane table at each position in turn (G^1, G^2) he verified his correct location by resection from trig. stations to the west and when the instrument was fixed at each position he sighted along the lines he had traced through the wood. The intersection of those lines gave the position of the gun at *B*.

Problem 3—The triangle and chain method already mentioned has reference to triangles fixed by trigonometry. However, under certain conditions, and where strict accuracy is not required, detail surveys may be run by chain if there are points to start and close upon, without the use of either transit or plane table. Fig. 3 is an example of this.

The first difficulty was found in not being able to cross the river, as no boat was available. But by establishing two points and producing a line through them intersections could be obtained as in plane tabling. Two

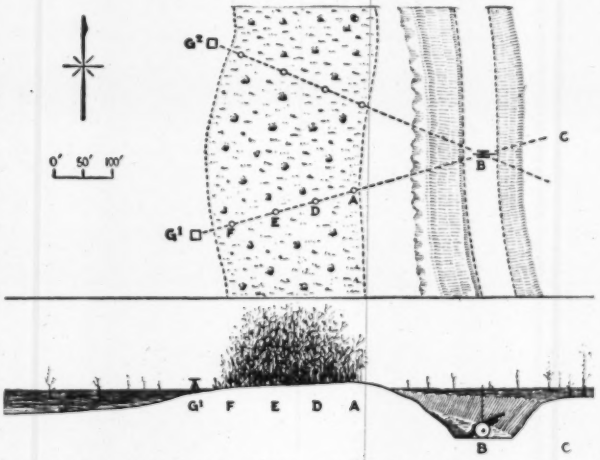


FIG. 2. LINES "BROUGHT OUT" TO LOCATE NEW GUN POSITION

pickets on an old east and west township line supplied the base, *A* and *B*. Another picket was set at *C* and a line chained from it through *B* along the river bank. A small triangle was laid off to locate the house. The returning line proved to run in the direction of a prominent object on the opposite bank (6). This object was noted, and located by an intersecting line through a stake (2) in line from *C* to (6). Another stake was put on the line *AB* at *D* and the chaining of the triangle *DBC* completed, the picket at (2) being read while doing so. The line *CD* was so arranged that the production of it would strike the end of the fence at (1) on the opposite bank. The intersecting line *FE* was also laid out to produce on the end of the fence, while at the same time watching the possibilities of following the river bank by a line from *F* through *A*. When the two sides *EF*, *FA* were chained this triangle was completed by chaining the remainder of the base line from *D* to *A*, the points (3) and (4) being read while doing so. The point at (5) was located in the same manner

the "Average Engineer"

as (6). The production of the fence noted at (3) and of the other one at (7) located the corner, as the eastern end of the top fence had already been fixed. The

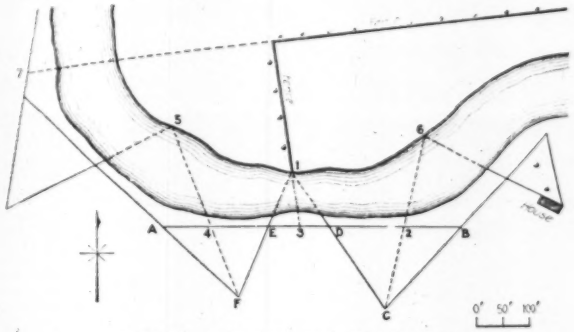


FIG. 3. SURVEY RUN BY "TRIANGLE AND CHAIN"

survey was carried about half a mile in this manner without any serious errors. The dotted lines shown on sketch are lines of sight only.

Diagrams for Designing Reinforced Concrete Chimneys

By F. E. Hertel
Stone & Webster, Inc., Boston, Mass.

THE diagrams presented herewith have been found to be particularly useful for the analysis of reinforced-concrete stacks, although they can be used for the analysis of any hollow circular reinforced-concrete beam or column subject to combined bending and direct stress. They can also be used for design by employing the trial method.

In addition to the usual assumptions adopted for the design of reinforced-concrete members, the two following assumptions have been made. (1) The reinforcing steel is replaced by an equivalent steel shell. (2) The reinforcing steel is located on the mean circumference of the concrete shell. The first assumption involves no appreciable error and the second is on the side of safety since the reinforcing steel is usually placed nearer the outside surface of the shell where it is more effective in resisting bending stress. In the computation the notation is as follows:

r = mean radius of concrete shell
t = thickness of concrete shell
N = normal component of all loads
e = eccentricity of N measured from the center of the section
p = ratio of reinforcing steel area to total area of section
n = ratio of modulus of elasticity of steel to modulus of elasticity of concrete in compression
α = one-half the central angle subtended by the neutral axis, as a chord, on the circle of radius r
θ = variable function of α
f_s = maximum unit tensile stress in reinforcing steel
f_c = maximum unit compressive stress in concrete
f_c' = maximum unit compressive stress in concrete at distance r from the center of the section
P = total compressive stress in concrete
P' = moment of P about neutral axis
S = total compressive stress in reinforcing steel
S' = moment of S about neutral axis
T = total tensile stress in reinforcing steel
T' = moment of T about neutral axis

From the fundamental formulas, sum of vertical forces = 0, and sum of moments of vertical forces about any point = 0, it follows that

$$N = P + S - T \qquad (1)$$

and by taking moments about the neutral axis

$$N\,(e - r\cos\alpha) = P' + S' + T' \qquad (2)$$

Substituting values, obtained by integrating between the proper limits, for the quantities on the right-hand side of the above equations, and dividing (1) by (2), the factors N, f_c' and t are eliminated and we have

$$\frac{e}{r} = \frac{(1-p)(\alpha - \sin\alpha\cos\alpha) + np\pi}{2\,[(1-p)(\sin\alpha - \alpha\cos\alpha) + np\pi\cos\alpha]} \qquad (I)$$

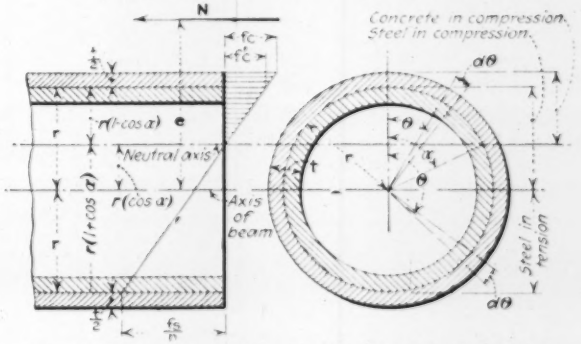


FIG. 1. DIAGRAM SHOWING REINFORCED-CONCRETE CHIMNEY

From equation (1) after substituting values for P, S and T we have

$$f_c' = \frac{N\,(1-\cos\alpha)}{2\,rt\,[(1-p)(\sin\alpha - \alpha\cos\alpha) + np\,\pi\cos\alpha]} \qquad (II)$$

Referring to Fig. 1, by proportion we find

$$f_s = \frac{nf_c'(1+\cos\alpha)}{1-\cos\alpha} \qquad (III)$$

and

$$f_c = f_c'\left(1 + \frac{t}{2\,r\,(1-\cos\alpha)}\right) \qquad (IV)$$

In order to simplify equations (II), (III) and (IV) let

$$A = 1 - \cos\alpha$$
$$B = \sin\alpha - \alpha\cos\alpha$$
$$C = \pi\cos\alpha$$
$$D = \frac{1+\cos\alpha}{1-\cos\alpha}$$

Then equations (II), (III) and (IV) become

$$f_c' = \frac{N\,A}{2\,rt\,[(1-p)\,B - npC]} \qquad \text{(IIa)}$$

$$f_s = nf_c'\,D \qquad \text{(IIIa)}$$

$$f_c = f_c'\left(1 + \frac{t}{2\,rA}\right) \qquad \text{IVa}$$

Fig. 2 has been plotted from equation (I) and shows the values of α, in degrees, for various values of $\frac{e}{r}$ and p, with $n = 15$. From Fig. 3 the values of A, B, C, and D, to be substituted in equations (IIa), (IIIa) and (IVa), can be obtained for the value of α found in Fig. 2.

As an example of the use of the diagrams, assume a reinforced-concrete chimney for which the stresses at the base are to be determined. At the base the internal diameter is 20 ft., the shell thickness 10 in. and the reinforcing consists of sixty ¾-in. square bars equally spaced. The weight of the stack above the base has been found to be 1,100,000 lb. and the moment about the base, due to wind load, is 7,500,000 lb.-ft. Assume $n = 15$.

N = 1,100,000 lb.

r = 125 in.

$e = \dfrac{7{,}500{,}000 \times 12}{1{,}100{,}000} = 81.8$ in.

$\dfrac{e}{r} = \dfrac{81.8}{125} = 0.655$

$p = \dfrac{60 \times 0.5625}{785 \times 10} = 0.0043$

t = 10 in.

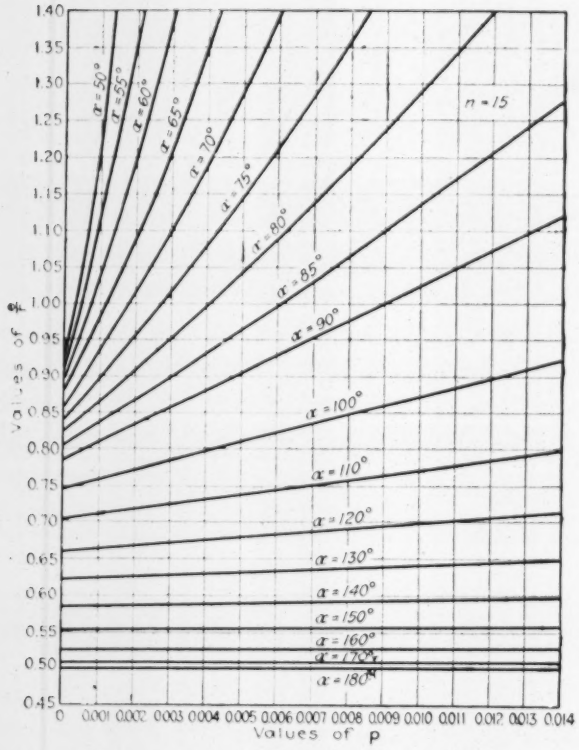


FIG. 2. CURVES FOR DETERMINATION OF α

From Fig. 2, α is found to be approximately 124° for which value the following are determined from Fig. 3.

A = +1.55
B = +2.05
C = −1.76
D = +0.27

substituting these values in equations (IIa), (IIIa) and (IVa) we have

$$f'_c = \frac{1{,}100{,}000 \times 1.55}{2 \times 125 \times 10\,[(1 - 0.0043) \times 2.05 - 15 \times 0.0043\,(-1.76)]}$$

= 318 lb. per square inch.

$f_s = 15 \times 318 \times 0.27 = 1{,}290$ lb. per square inch.

$$f_c = 318\left(1 + \frac{10}{2 \times 125 \times 1.55}\right)$$

f_c = 326 lb. per square inch.

It will be noted, by referring to Fig. 2 that for values of $\frac{e}{r}$ less than 0.5 there is compression over the entire section. For such cases the ordinary moment of inertia theory will apply.

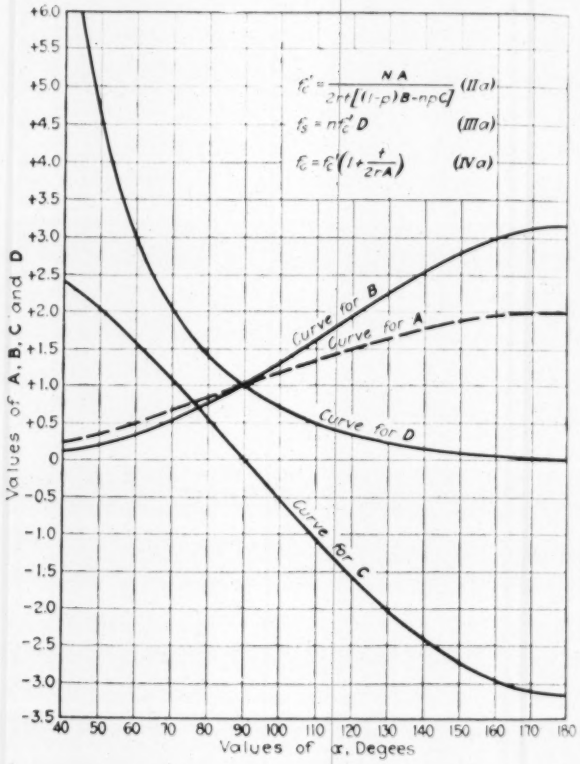

f'c = N A / 2rt[(1-p)B-npC] (IIa)
fs = nf'c D (IIIa)
fc = f'c(1+t/2rA) (IVa)
Values of A, B, C and D
Values of α, Degees
Curve for B
Curve for A
Curve for D
Curve for C

FIG. 3. CURVES FOR DETERMINATION OF A, B, C, AND D

Ready Computation of Areas in Acres

BY H. N. BRADSTREET
U. S. Mineral Surveyor, Mesa, Ariz.

TO DIVIDE by the outlandish number, 43,560, to compute acres in land surveying is a nuisance, and this may be readily done by a decimal system, passing directly from some unit of measure to acres. Of course, there is such a unit in the almost obsolete system used by the United States in measuring the public domain, in which 80 chains make a mile and 10 square chains constitute an acre. But to transform feet into chains is usually considered as difficult a task as to change square feet into acres. But there is a simple way of changing feet to chains by converting all distances in feet into chains, by a repeating decimal method, multiplying distances together for square chains, and pointing off one place to the left for acres.

The conversion is based on the relations:

100 lks. = 1 ch. = 66 ft.

1 ft. = 100/66 = 1.5151515 lks.

Instead of dividing the number of feet to be converted into chains by 66, multiply by its reciprocal.

the "Average Engineer"

The repeating fraction 151515151515, which operation is performed as follows:

Change 983,245.8 ft. to chains
Repeating fraction 151515151515

983245.8	represents the figure 1	in the fraction
491622.9	represents the figure 5	in the fraction
1474868.7	represents the group 15	in the fraction
14748.687	represents the group 15	in the fraction
147.48687	represents the group 15	in the fraction
1.4748687	represents the group 15	in the fraction
.14748687	represents the group 15	in the fraction
.014748687	represents the group 15	in the fraction

14976.63.636 chains.

The result can be carried to any desired degree of accuracy.

A Method for Laying Out Rise and Run of Stairways

By Raymond C. Reese
Pittsfield, Mass.

LAYING OUT and arranging stairs is usually the province of the architect, but the structural engineer is sometimes called upon to obtain well-proportioned stairs; i.e., stairs with proper rise and run. The following analysis has been found useful:

To avoid ambiguity in the use of terms, Fig. 1 has been prepared to show the meaning of such terms as

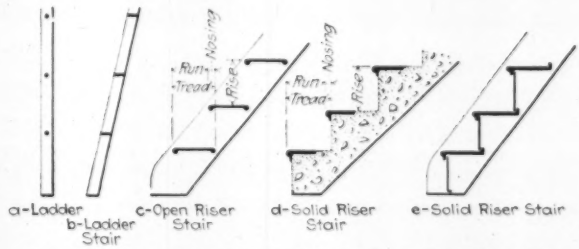


FIG. 1. STAIRWAY TYPES AND DIMENSIONS DEFINED

ladder, ladder-stair, open-riser stair, closed-riser stair, and the frequently confused rise, run and tread.

The curves in Fig. 2 were plotted to obtain a graphical comparison of the principal formulas expressing the relation of rise to run. These formulas are of three general types: (1) Rise × Run is a constant varying from 66 to 75, or generally from 72 to 75; (2) Rise + Run is a constant varying from 17 to 17½; and (3) 2 Rise + Run is a constant varying from 23 to 25. The first of these is, of course, an hyperbola, and the second a right line at 45 deg. While they give good results when the rise is in the vicinity of 7 in. or 7½ in., they call for very steep stairs at the higher values of the rise, and very shallow ones for the lower values. The third type of formula improves on the two others, by changing the slope of the right line, resulting in a more balanced stair for widely varying values of the rise.

Still another type of relationship is shown on the plot from the Cleveland Building Code, as given in the *Engineering Record*, Aug. 28, 1915, p. 260. From this curve the writer has derived the formula: Rise = 25.4 Run — 0.5359. While this gives consistent results, it is a bit awkward to remember and apply, and a more convenient and simpler formula is: Rise × √Run = 23½, which is shown by the heavy line on Fig. 2. This equation is readily solved by one setting of the slide rule.

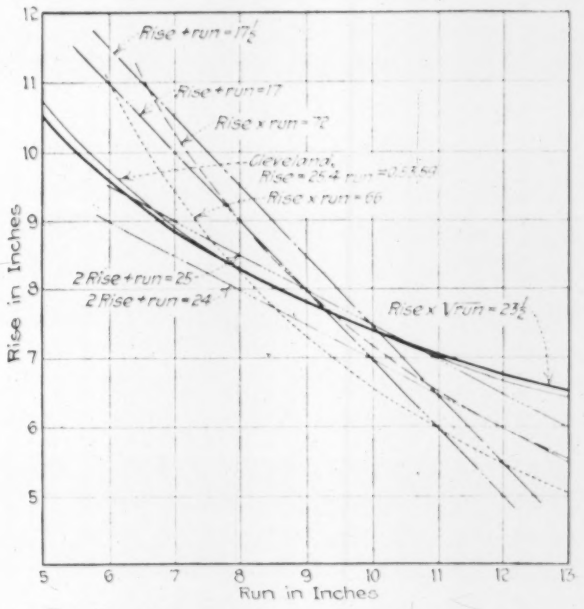

Rise + run = 17½
Rise + run = 17
Rise x run = 72
Cleveland
Rise x run = 66
2 Rise + run = 25
2 Rise + run = 24
Rise x √run = 23½
Rise in Inches
Run in Inches

FIG. 2. CURVES FOR STAIRWAY DIMENSION FORMULAS

On the basis of this formula, Fig. 3 was drawn to be used as a standard for the design of stairs. It indicates the relationship between rise and run for all stairs and what seem to be suitable limits for the use of ladders, ladder-stairs and the like. At the lower end of the curve, for slopes of 15 deg. or 18 deg. and less, ramps would be used instead of stairs.

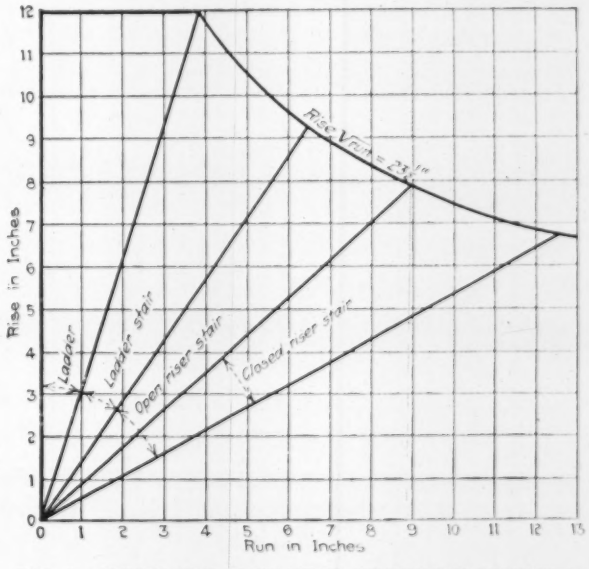


FIG. 3. CURVE FOR SIMPLIFIED DIMENSION FORMULA

On the original drawing from which Fig. 3 is taken, directions were included for the width of stairs and exit doors, the styles of safety treads to be used, headroom required, etc., all of which must have attention in the design of a stairway.

Diagram to Determine Turbine Specific Speed

By E. A. Van Deusen
Jackson, Mich.

In the preliminary investigation and design of hydro-electric developments it is frequently necessary to know, before consulting the manufacturers, the probable specific speed and revolving speed of the turbines. The usual procedure is to assume either the specific speed or the r.p.m., and then to ascertain the other unknown factor from a suitable diagram or the usual formula

$N_s = \frac{N\sqrt{HP}}{H^{5/4}}$, in which N_s = specific speed, N = r.p.m., HP = horsepower, and H = head in feet. This method however is not always satisfactory, and moreover, it is sometimes a difficult matter to judge what should be the specific speed.

The appended chart overcomes this difficulty to some extent, for with a given head and power, both the probable specific speed and r.p.m. can quickly be determined.

The curve of specific speeds was obtained by plotting the speed characteristics of more than one hundred existing plants against their respective heads, and then passing a smooth curve through the centers of gravity of the various groups. There was found a wide divergence in the specific speeds for any given head, indicating lack of agreement as to what is the desirable specific speed for the head in question. However, it is believed that the curve shown represents the average and probable desirable values. It is interesting to observe that this curve very closely follows Pfau's classification for successful turbine operation.

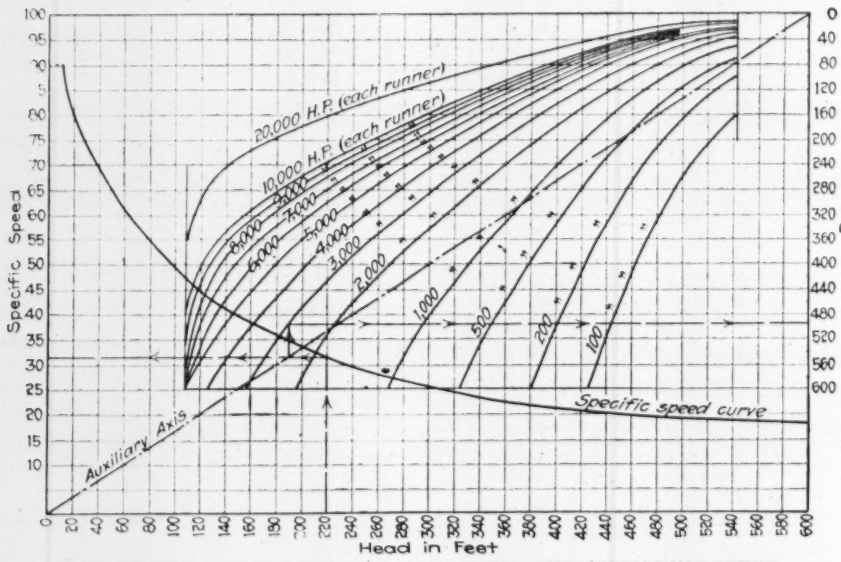


CHART FOR DETERMINING SPECIFIC SPEED AND REVOLVING SPEED OF TURBINES

This chart refers only to Francis single-runner reaction turbines and should not be used for the Nagler high-speed runner, nor for impulse wheels. When used for multiple-runner Francis turbines, the h.p. per runner, not per turbine, is to be used.

As an example in the use of the chart, assume a head of 220 ft., and a 3,000 h.p. single-runner Francis turbine. Enter the chart at 220 ft. head on the axis of abscissas, pass vertically upward to the specific speed curve and read the specific speed on the axis of ordinates as 31.5. From the intersection with the specific speed curve pass horizontally to the diagonal auxiliary axis, then vertically upward to intersection with the curve for 3,000 h.p. On the right axis of ordinates can then be read an r.p.m. of nearly 500.

It should be understood that this chart is only intended to be used as a guide for the preliminary selection of runners. The final decision on specific speed, r.p.m., etc., is a matter to be carefully considered later and may be affected by other factors not taken into consideration at the time of the preliminary investigation.

A Group of Articles for

Concrete Monuments Mark Miami District Property

By C. S. Bennett
Field Engineer, Miami Conservancy District, Dayton, Ohio

Special concrete property mounments with brass markers have been used for marking property corners on lands of the Miami Conservancy District, including rights of way for the location of levees and walls, borrow pits and earth dams. Since 2,000 monuments were required a study was made of the most economical and satisfactory design and the best method for placing them.

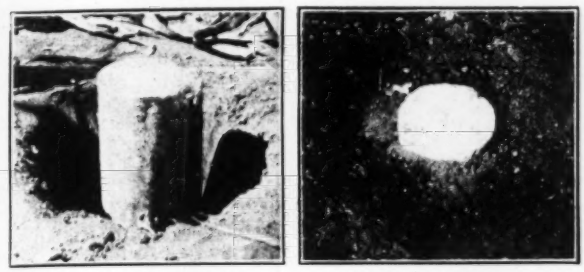
A monument of circular section was chosen, with top diameter of 8 in. and a bottom diameter of 9 in., with a standard length of 36 in., the taper facilitating the pulling of sheet iron forms. When rock was encountered the length, of course, varied. The monuments were cast in place, the markers being placed and centered while the concrete was green. A 1:2:4 mix was used for the concrete, with a richer mix on top to facilitate smoothing of the top surface. The two photographs show the monument before the form was pulled, with its flanges at the side, and after the form had been pulled and earth tamped in. Details of the marker are shown in the accompanying drawing.

Forms consisted of one piece of sheet iron with a pair of flanges turned out to take three bolts with wing nuts as clamps. The bolts were released after concrete had set. The form was easily withdrawn. The general method employed was to dig holes for from four to eight monuments, depending on the distance between them, after preserving the location of the transit points by the string intersection method. Then the forms, with bolts tightened, were placed in position and filled with concrete. The markers were placed at once and the top of the monument pointed up with a trowel. The markers were carefully centered when placed, although final

the "Average Engineer"

centering was done after the forms were pulled and part of the backfill made. Forms were removed within 24 hr., the position of the center point checked (and adjusted when necessary), and backfill was tamped in.

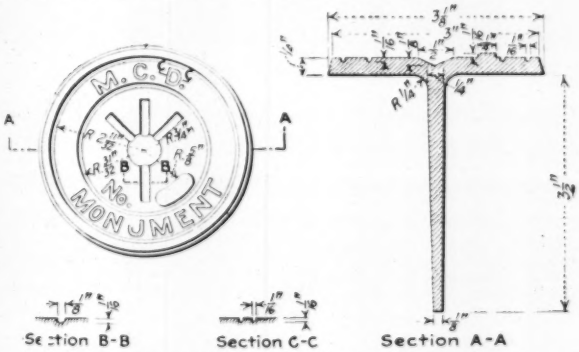
The markers were of special design, cast of brass and weigh about 12 oz. each. The crow foot was devised as a symbol and the center of the depression in the middle marked the transit point. The prong was bent, before placing the marker, to hold it in place, the beveled edge



PROPERTY MONUMENTS FOR MIAMI DISTRICT

also serving this purpose, embedded in the concrete with top face flush.

Marking was recorded only by number in the blank space provided opposite the letters "No." An index was made of all monuments and the necessary references and descriptions recorded while in the field. Usually the monuments projected about 1 in. about the surface of the ground when completed, but when placed in highways or other exposed points they were lowered so that the top was from 6 to 9 in. below the surface.



SPECIAL MARKER FOR PROPERTY MONUMENTS

A truck with two bins for sand and gravel, a water cask with pipe and hose connections was used.

The work was done for the Miami Conservancy District, Arthur E. Morgan, chief engineer, and Charles H. Paul, assistant chief engineer.

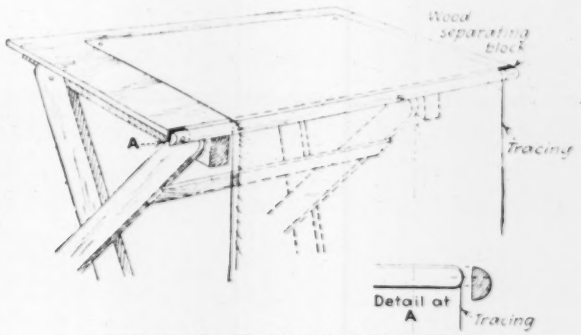
A Collection of Beam Design Diagrams

S. M. Cotten, of Phoenix, Ariz., has gotten out a series of blueprint charts for the design of beams of reinforced concrete or timber of both rectangular and T form. ($3.) The charts are quite readable and clear. They are devised on a new system of transformation ratios whereby the original diagrams for certain fixed quantities of design are readily transformed.

To Protect Tracings on Drafting Board

By H. G. Fay
West Somerville, Mass.

The accompanying sketch of a drawing board shows half-round strips to protect tracings from harmful creasing. I think this is an improvement over the drawing of C. Nye which you printed in *Engineering News-Record* of May 6, 1920, p. 929, inasmuch as the molding is separated from drawing board by wood blocks. Thus the tracing may be placed between the molding and drawing board—the edge of which is to be rounded so the tracing is doubly protected as no pressure can come on tracing while leaning over it. The cost of installing is practically the same.



ROUND STRIPS PROTECT TRACINGS

Moments for Continuous Beams of Uniform Live Load

By H. M. Gibb
Rawalpindi, India

VALUES of positive and negative moments for continuous reinforced concrete floor and roof slabs and beams under moving uniform live loads are standardized by the Joint Committee on Concrete and Reinforced Concrete as follows:

$$M_1 = + \frac{wl^2}{10}$$

$$M_2 = - \frac{wl^2}{12} \quad \left(\text{or } - \frac{wl^2}{8} \text{ for two spans}\right)$$

$$M_3 = + \frac{wl^2}{12}$$

These values have been derived primarily with a view to the design of slabs for bridge and building floors and flat roofs. When almost any other kind of continuous slab or beam is considered, however, such severe conditions from moving live load do not generally exist as the live load is not movable along the spans and for such structures some reduction of the above moment values should be permissible.

All structures subject to earth or fluid pressure come under this category which includes foundation slabs and beams, face and base slabs of counterfort retaining walls, sloping roof slabs, and the floors and walls of water tanks and silos.

In the recommended values of the moment coefficients in Tables I and II, the center moments have been considerably increased over what is actually required to compensate for any probable departure from the ideal.

Table I gives the moment coefficients of wl^2 for equal spans and uniform load (see American Civil Engineers' Handbook, 1920, p. 357).

As the intermediate supports are of appreciable width, the moments at supports may be safely replaced by the moments at the edges of the support. Assuming that the average width of supports is l 10, an inspection of the moment diagram shows that moments M_2 can be multiplied by 4/5 and moments M_3 by 3/4.

The last two columns give the moment coefficients of wl^2 in decimals and fractions which would appear to meet best the requirements of theory and the uniformity desirable in design.

For three or more spans the moments for design in the end spans are greater than the moments for the intermediate spans and supports by 33 per cent. This lack of uniformity in the moment coefficient can be overcome by making the end span shorter that the intermediate ones.

An investigation, by the theorem of three moments, of the effect of shortening the end span shows that for three or more spans the best balanced condition results when the end span is 8/10 of the intermediate span.

Table II gives the moment coefficients of wl^2 for this case, l being the length of the intermediate span.

An inspection of the moment diagrams shows that for a support of width l/10 the moment at the edge of the support is 3/4 of the support moment.

The last two columns give the moment coefficients of wl^2 in decimals and fractions.

In both tables, the recommended values of M_2 and M_3 are at least 50 per cent in excess of the required values. The considerations which have influenced the recommended values are that the center moments for design should be in excess to compensate for slight settlement of supports or the deflection of the supporting beams and also in Table II, that the sum of the plus and minus moments is not less than $wl^2/8$.

The above results may be specified as follows:

Where the live load on continuous reinforced concrete beams or slabs is uniformly distributed and is not capable of motion to cause uneven distribution (as in foundations, retaining walls and all slabs retaining fluids) and the spans are all equal,

$$M_1 = +\frac{wl^2}{12}$$

$$M_2 = -\frac{wl^2}{12}, \text{ or for two spans} = -\frac{wl^2}{10}$$

and points of contraflexure are l/4 from center of support M_2.

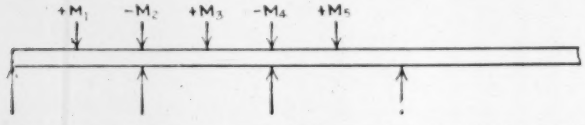
$$M_1\ M_3\ M_5 \text{ etc.} = +\frac{wl^2}{16}$$

MOMENT COEFFICIENTS FOR BEAMS UNDER STATIONARY LIVE LOAD

TABLE I

l = span, w = load/foot run

All spans equal	2 Spans		3 Spans			4 Spans				5 Spans				
	$+M_1$	$-M_2$	$+M_1$	$-M_2$	$+M_3$	$+M_1$	$-M_2$	$+M_3$	$-M_4$	$+M_1$	$-M_2$	$+M_3$	$-M_4$	$+M_5$
Theoretical coefficients of wl^2	0 07	0 125	0 08	0 10	0 025	0 077	0 107	0 036	0 071	0 078	0 105	0 033	0 079	0 046
		×4/5		×4/5			×4/5		×3/4		×4/5		×3/4	
Moments at edge of support		0 10		0 080			0 085		0 053		0 084		0 059	
Recommended for use: Decimals	0 083	0 10	0 083	0 083	0 062	0 083	0 083	0 062	0 062	0 083	0 083	0 062	0 062	0 062
Recommended for use: Fractions	1/12	1/10	1/12	1/12	1/16	1/12	1/12	1/16	1/16	1/12	1/12	1/16	1/16	1/16



and points of contraflexure are l/5 from center of support M_2.

Where the end span is made 8/10 of the intermediate spans the moments for three or more spans are

TABLE II

End spans = 0.8 l, Intermediate spans = l, w = load/foot run

	3 Spans			4 Spans				5 Spans				
	$+M_1$	$-M_2$	$+M_3$	$+M_1$	$-M_2$	$+M_3$	$-M_4$	$+M_1$	$-M_2$	$+M_3$	$-M_4$	$+M_5$
Theoretical coefficients of wl^2	0 045	0 082	0 043	0 045	0 082	0 043	0 034	0 044	0 082	0 042	0 084	0 042
		×3/4			×3/4		×3/4		×3/4		×3/4	
Moments at edge of support		0 0615			0 0615				0 0615		0 063	
Recommended for use: Decimals	0 062	0 062	0 062	0 062	0 062	0 062	0 062	0 062	0 062	0 062	0 062	0 062
Recommended for use: Fractions	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16

$$M_1\ M_2\ M_3\ M_4\ M_5 \text{ etc.}, = +\frac{wl^2}{16},$$

and points of contraflexure are l/5 from center of supports and l is the length of the intermediate span.

In the above

M_1 = Moment in first or end span near the center.
M_2 = Moment at second support of end of first span.
M_3 = Moment in center of second span.
M_4 = Moment at third support.
M_5 = Moment in center of third span.

Consulting Engineers Education of Employees

IN Chicago a firm of consulting engineers, to educate and broaden the horizon of its staff, periodically gives a dinner for the staff to which a few representative men of the profession are invited. No speeches are made, the idea being simply to get together socially. The scheme had a three-cornered recompense. The firm builds interest and loyalty in its staff, the guests learn something of the individuality of the firm and the staff broadens its acquaintance. After the dinner an excursion is often arranged to view work of the firm or of some other engineer going on in the city or its vicinity. Another firm of consultants in Kansas City has recently come to the conclusion that there are too many commercial products being used by them of which all but a few members of their staff know too little. To educate their members they make it a point once a week to ask in some manufacturer's representative to speak for an hour on those products of his company which are of interest to the staff.

New Concrete Arch Survives Washout of Centers

Flood Carries Away Falsework Twelve Hours After Arch Rib Was Completed With No Disastrous Result

By C. Leland Wood
Civil Engineer, Herkimer, N. Y.

During the construction last winter of a new reinforced-concrete arch bridge over West Canada Creek near Herkimer, N. Y., a sudden rise in the creek to flood stage carried away the arch centers and left an arch entirely self supporting, within a period of less than twelve hours from the time that the concrete was completed. Although the carrying away of the centers by flood must have racked them some time before they went out, the arch was left uninjured. The crown deflection of about ¾ in., which occurred was but little more than the arch should have taken if the centers were struck with eight-day concrete. A careful examination of the arch ring concrete showed no evidence of cracks or other injury. This premature striking of the arch centers, under such unusual conditions affords some idea of the large factor of excess strength which is inherent in a concrete arch of proper design.

This new bridge is to replace the present old covered wooden bridge of three spans, which has served traffic on this highway for about 95 years, and is located a few feet down stream. It consists of three arches over the stream and three girder spans over the railroad. Each arch has a span of 86 ft., a rise of 20.5 ft., and consists of two 5-ft. ribs spaced 8 ft. apart, having a thickness of 1.8 ft. at the crown and 5 ft. at the springing line. The reinforcement in the arch ribs consists of twenty ⅞-in. longitudinal bars, 10 placed near the intrados and 10 near the extrados. Transverse rods, spaced about 8 ft. on centers, tie together the main reinforcing bars, and hooked rods placed radially connect the tie rods.

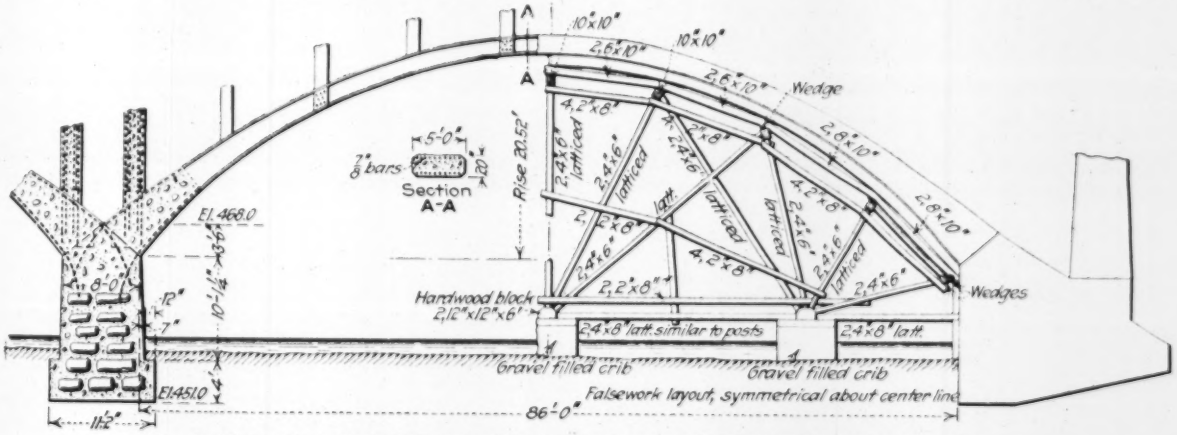
The concrete in the arches is of a 1:2:4 mixture, the aggregates being bank sand and crushed limestone rock. The concrete in the piers and abutments is of a 1:3:6 mixture, using screened gravel and creek sand.

The centering of the northerly arch was of a fan-shaped design and the foundation for this falsework consisted of gravel filled boxes set in the bed of the stream. These boxes were bottomless and about 4 ft. deep. They were placed on the stream bed, in water not over 18 in. deep, and were then filled with gravel and rock to support timber sills. The arch centering and gravel boxes are shown in the accompanying drawing.

The temperature of the atmosphere previous to and during the time the concrete of the first arch was poured was about 34 deg. F. Because of the mild weather, the aggregates used in the concrete for this arch were not heated, except for what heat was imparted by the hot water used in mixing, so the mixture went to the forms at a temperature of not more than 55 deg. F.

THE ARCH AFTER CENTERS WERE WASHED AWAY

The upstream rib of the first arch was poured Saturday, Nov. 20, 1920, and the downstream rib, with the connecting struts, was poured Monday, Nov. 22, the work being completed at 6 p.m. each day. Due to a rain on the night following the pouring of the last rib, the water in the stream rose approximately 5 ft., and this flood, along with driftwood, washed out or undermined the gravel boxes and carried out some of the centering at 6 o'clock the next morning. Thus within twelve hours after the last concrete was placed, the centering was entirely struck, so it could be readily seen that there was no point of contact between the arch form and the falsework. This same condition existed in both ribs of this arch. Upon a more detailed investigation no cracks were observed in the struts connecting the ribs or in any other point of the arch.



DETAILS OF CONCRETE BRIDGE FROM WHICH CENTERS WERE WASHED OUT

This bridge is being built partly to eliminate a grade crossing, for the towns of Herkimer and Fairfield and the New York Central R.R., E. J. Doyle of Albany, N. Y., is consulting engineer, the writer is resident engineer for the towns, William McClellan is resident engineer for the railroad, and the Peckham Construction Co., of Buffalo, is the contractor.

Economics of Highway Improvements

Analysis Based on Conditions in Summit County, Ohio, to Determine Limits to Cost Between Which Is Economy and Outside Which Is Waste

By H. G. McGee
Bureau of Municipal Research, Akron, Ohio

Analyses of road systems based on the conception of a road as a business investment are rare. The following economic study of the highways of an Ohio county, which is condensed from a report made by the Bureau of Municipal Research of Akron, Ohio, has, therefore, special interest. It is based on the sound theory that transportation returns are a measure of the value of highway improvement. Ordinarily it is assumed that lack of traffic data makes such studies inconclusive. This article indicates that search will disclose sufficient information to permit tentative conclusions. At least the roads which may be profitable can be separated from those certainly not profitable. Finally the article indicates clearly that temporary surfacing, at the cost of higher maintenance charges, is wiser practice than the invariable construction of paved roads, even on main lines of travel.—Editor.

IMPROVED highways are assets when and where there is traffic, and as they lower the time and money cost of operating conveyances over them. Road improvements involve expense in proportion to their maintenance and fixed charges. Effective and efficient highway management may be expected to strike a balance between improvement expense and operating savings, with reasonable provisions for emergencies and growth. What seem to be the savings which determine proper expenditures for roads?

An analysis of traffic in Summit County, Ohio, in which Akron is the principal city, is the basis of the following attempt to answer this question for this region. Ten years' growth in automobile registrations and in road improvements in this county are shown by Table I.

TABLE I. TEN YEARS' GROWTH IN AUTOMOBILE REGISTRATIONS AND IN ROAD IMPROVEMENTS IN SUMMIT COUNTY, OHIO

Item	1910	1920	Per Cent Increase
Automobiles registered in Ohio	32,941	615,000	1,764
Automobiles registered in Summit County	1,198	34,000	2,740
Miles of road improved by Summit County to date	3.32	130.53	3,830
Outlay for road improvements in county to date	$24,424	3,201,143	1,310
Outlay to date per mile of road improved	7,350	24,500	236
Outlay per registration	20.45	$102.40	401

The method of this study is to take traffic apart, examine the limitations and possibilities of each part, and then add these possibilities together again for each road under consideration. For this purpose, traffic is separated into (1) local or suburban (2) rural and (3) inter-city or through.

The apparent neglect of pleasure traffic may invite question. This neglect is more apparent than real, since pleasure traffic is included in the through traffic counts; further, if roads are properly improved for rural and inter-city traffic, it is quite possible that they may also be adequate for pleasure traffic; and lastly, it may be a question of just how much of community income, in taxes, it is just to expend for the lessening of pleasure riding costs alone.

Local or Suburban Traffic

Local or suburban traffic is that which arises from the extension of built-up city areas across corporation lines. Being identical with interior traffic it ought to be provided for physically and financially as is interior traffic, viz., by the construction of streets almost wholly paid for by special assessment on the benefited property.

A slight variation of this case appears where road improvements are requested in anticipation of local traffic, that is, to make allotments salable. Assuming that the county is justified in taking the chance of investing its capital in anticipation of allotment development, it may be fair to limit such expenditures to the maximum possible return such allotment areas might make to the county road fund during the life of the improvement. Under existing conditions, such a policy would allow the construction at most of one mile of paved road to each 1¼ square miles of new allotments, as is indicated by Table II. Since the maximum profitable mileage will hardly cover intersections

TABLE II. EXPENDITURE FOR ROADS JUSTIFIED BY LOCAL OR SUBURBAN TARFFIC

Item	Amount
Area of Summit County in acres	253,165
Assessed valuation, exclusive of city of Akron, Sept., 1920	$140,774,790
Assessed valuation per acre for county	$550
Area of the city of Akron in acres	16,024
Assessed valuation of the city of Akron, September, 1920	$375,006,140
Assessed valuation per acre for city	23,300
Difference between average county and average city acre	22,750
County tax levy for roads, for 1921, cents per $1,000	$1
Annual expenditure per acre for roads justified by $22,750 increase in valuation	$7.05
Amount of ten-year 5% equal annual payment bonds which $7.05 per year will carry	$54.50
Average bids on reinforced-concrete roads, October, 1920, per mile	$47,642.31
Number of acres required to be increased $22,750 each to pay for building one mile of road at $47,642.31	874

plus 2 per cent in a well-developed street system, the following Ohio city rule seems also justified for the county.

The public's share in the improvement of roads in residential sections or for allotment development shall be limited to 2 per cent plus the cost of intersections.

Rural Traffic

Rural traffic starts or ends away from towns or cities; it is farm to market traffic primarily. Tax values along Copley road, serving an almost solely agricultural district, and farm hauling in Hudson township, Tables III and IV, are taken as bases. Table III indicates that a good road adds from $18 to $33 an acre to taxable property values.

TABLE III. INCREASE IN LAND VALUES BY ROAD IMPROVEMENTS AS EVIDENCED BY ASSESSED VALUATIONS

Item	Amount 1915	Amount 1920
Acres of lands in Copley township	16,664	14,200
Assessed value of 14,200 acres	$901,680	$2,199,460
Assessed value per acre	$54.11	$154.80
Percent increase in value per acre, 1915–1920		186
Copley Road No. 2		
Acres in eleven tracts on Copley Road No. 2		269.78
Assessed value per acre of 269.78 acres in 1915 (before improvements)		$72.60
Difference in value per acre between eleven tracts and average of township in 1915		$18.49
Assessed value per acre of 269.78 acres in 1920 (after improvements)		$207.00
Difference in value per acre between 11 tracts and average of township in 1920		$52.20
PORTION OF INCREASE WHICH MAY BE DUE TO ROAD IMPROVEMENT		$33.71
Average assessment per acre on 269.78 acres for road		$4.63
Copley Road No. 3		
Acres in ten tracts on Copley Road No. 3		313.33
Assessed value per acre of 313.33 acres in 1915 (before improvement)		$64.10
Difference in value per acre between ten tracts and township in 1915		$9.99
Difference between value per acre between 10 tracts and township, 1920		$28.20
Assessed value per acre of 313.33 acres in 1920 (after improvement)		$183.00
PORTION OF INCREASE WHICH MAY BE DUE TO ROAD IMPROVEMENT		$18.21
Average assessment per acre on 313.33 acres for road		$4.84

TABLE IV. COST OF FARM HAULING IN HUDSON TOWNSHIP, BASED ON CROP REPORTS OF 1917 AND INFORMATION FURNISHED BY COUNTY AGRICULTURAL AGENT ON OCTOBER 23, 1920.

Produce hauled: 6,633 acres seeded produced 1 348 tons per acre of which 68 2% were moved from producing farm	6,078.1 tons
Backhaul: Fertilizer, lime, and feed hauled from town to farms	1,396 tons
Total produce and supplies hauled during year	7,474 1 tons
Average distance from farms by road to center of village of Hudson, shipping point and mill, in miles	2 38
Total farm haul for township during the year, 7,474 1 tons moved 2 38 miles, in ton-miles	17,800
Average price of team and man per 10-hr. day, capacity of 1-ton on earth roads	$7 00
Cost per ton-mile by $7 00 a day team, going 2 miles an hour loaded and returning at 3 miles an hour empty	$0 58
Total cost of hauling 17,800 ton-miles at $0 58 each	$10,320
Total acreage of township, including woodlots, swamp, waste, and other uncultivated areas	10,042
Total haul per gross acre yearly, in ton-miles	1 77
Annual cost of producing 1 77 ton-miles per acre at $0 58 each, subject to reduction by road improvement	$1 027
Maximum outlay in 5% ten-year annuity serial bonds per acre which saving of entire $1 027 a year would justify	7 94
Maximum outlay at 5% on which $1 027 a year would pay interest only (assuming no depreciation and no consequent need for amortization of investment)	$20 60

Table IV summarizes the extent of farm hauling in 1917 in Hudson township. It was about an average crop year. The length of haul is perhaps short of the average, resulting in a small ton-mileage per acre. For an improvement whose probable life is ten years and which would wipe out hauling cost entirely, an outlay of about $8 an acre is apparently justified. Since, however, improved roads allow the farmer to haul at the slack season and possibly, to sell at most favorable price seasons, and bring recreational centers, schools and churches within reach the year round, they may net him more than the entire hauling cost. These other benefits may apparently increase the total benefit to between $20 and $30 an acre. There are about 1·88 miles of road to each 640 acres in Summit County.

Ordinarily a road improvement does not increase other county governmental costs, and the increase in land values after improvement automatically increases the county tax revenues for other than road purposes. It may be fair, therefore, for the county or township, to assume so much of the cost of the improvement as will be returned to it in increased taxes. In Summit county, the total county levy has for several years been about three mills. At $25 an acre increased valuation, three mills will produce $25.50 per 340 acres. At 5 per cent, $510 will purchase an income of $25.50 a year. Fairness, therefore, would seem to justify a general county contribution of about $500 per mile of road improvement for rural traffic.

At $25 an acre benefit, and 340 acres per mile of road in the county a total of $8,500 a mile apparently reaches about the maximum economic investment in road improvements for the benefit of agricultural lands; of this amount, about a third may be expected to be balanced by lowered hauling costs, and $500 may be justly carried by the general county tax levy.

Inter-City or Through Traffic

For each vehicle traveling a certain road, any improvement worth paying for will save something of the time and money cost of operating over it. Obviously, this saving per vehicle cannot exceed the total cost of operating over the road without improvement. Practically, it may be limited also by the cost of some alternative means of transportation, as railway. This saving per vehicle or any other unit, multiplied by the annual number of such units passing over the improvement, will produce a gross annual saving. But, within rather wide limits, the total cost of the improvement for interest, depreciation, and maintenance, may vary only slightly with the number of vehicles or other units passing over it. The net value of the improvement then, will depend upon there being enough traffic to pile up a sufficient number of unit savings to exceed the cost of the improvement.

Through traffic probabilities in Summit county are estimated on the basis that the following principles hold: (1) Highway traffic will be proportional to the product of the populations connected; (2) it will vary inversely with the distance between centers; and, (3) beyond a somewhat indefinite distance between centers, say fifty miles, highway haul does not seem to have proved sufficiently economical yet to justify public expenditures for its sole use.

It has been generally observed that increased traffic follows road improvements. If improvement costs are to be less than operating savings, it seems vital to be able to estimate what traffic will be after a contemplated improvement is completed. For this reason, only counts on improved roads have been used in the following estimates.

If the principles indicated above hold and if available counts are truly representative of the total annual traffic, then there ought to be some constant relation between traffic counts and the populations of and the distances between the cities connected by the roads where the counts are made. Four traffic counts, taken at three points in or near Summit County were studied in detail to discover evidence of this constant. This study is summarized in Table V.

TABLE V. SUMMARY OF RELATIONS INDICATED BETWEEN TRAFFIC FACTORS AND ACTUAL COUNTS

	Freight Service								Passenger Cars				
	Road Traffic Factor	No. of Trucks Weekly	No. of Trucks in 30 Weeks	Average Load per Truck, Including Empties	Tons Moved Annually	Tons per Unit of Traffic Factor	Difference Between Col. 7 and Average of Col. 7	Col. 8 Squared	No. of Cars Weekly	No. of Cars in 30 Weeks	No. Cars per Unit of Traffic Factor	Difference Between Col. 12 and Aver.	Col. 13 Squared
Cleveland-Akron, May 18-25, 1918	3,333	1,438	43,140	2 33	100,400	30 1	15	225	6,586	197,500	58 3	11 7	137
Cleveland-Akron, May 6-7, 1920	4,620	2,740	82,200	2 50	205,500	44 4	0 7	0 49	9,450	283,700	61 4	8 6	74
Akron-Kent, May 6-7, 1920	3,060	2,270	68,000	2 50	170,000	55 6	10 5	110 25	9,975	299,500	97 8	27 8	772
Pittsburgh-Youngstown, June 16-17, '20	3,090	3,030	90,900	1 77	161,000	52 0	6 9	47 6	6,940	208,000	67 4	2 6	6 75
Totals and average	14,103	9,478	284,240	2 24	636,900	45 1	8 27	95 83	32,951	988,700	70 0	12 7	247 19
Standard variation	.....	.....	.....	.....	.....	.....	.....	9 8	.....	.....	.....	.....	15 7
Probable error	.....	.....	.....	.....	.....	15 1%	6 9	6 6	.....	.....	15 2%	10 7	10 6

Intercity traffic may be expected to flow from each city on one side of a counting point to each city on the other. For each of these traffic points, then, cities within about 50 miles of each other were listed. Tabulations were made of their populations in thousands at the time of count and the distances between their centers in miles, measured on a large scale map. For each pair of cities, these population figures were multiplied together and their product divided by the distance between them in miles. The sum of all these quotients, for a given road at a given point was called, for want of a better name, the "traffic factor" of the road at that point.

TABLE VI. TWO-TON TRUCK TESTS REPORTED IN SERVICE BULLETIN, IOWA STATE HIGHWAY COMMISSION

Type of Surface	Pounds Pull per Ton	Miles per Hour	Miles per Gallon
Earth	92—218	4 6	5 76
Gravel	78 2—81 3	9 5	7 19
Macadam	64 3	(12 6)	9 48
Paved	27 6	16 4	11 44—11 78

Fig. 3 (hourly and daily variations in road traffic counts) indicates variations which may be expected for truck, passenger car, and horse-drawn traffic from hour to hour and for different days of the week. On the basis of these curves the four counts were expanded to estimates for one

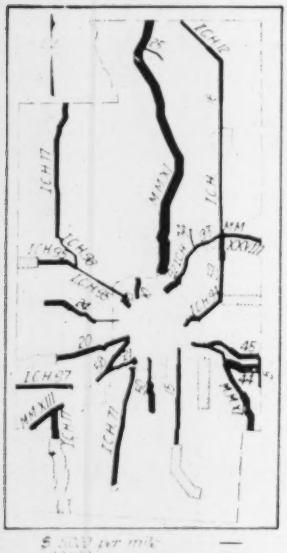


FIG. 1. RELATIVE COSTS OF IMPROVEMENTS IN DOLLARS PER MILE

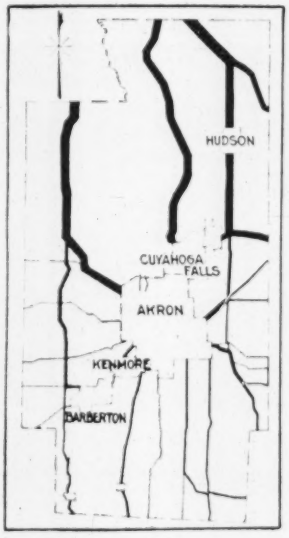


FIG. 2. RELATIVE THROUGH TRAFFIC DEMANDS BASED ON POPULATIONS AND DISTANCES

Amount of traffic is indicated by relative strength of lines representing roads.

week's traffic. Tonnage for trucks was based on the observed size of each truck and the number of trucks which were loaded. Horse-drawn traffic was eliminated as probably rural and not intercity; and the inclusion of farm motor traffic may result in a somewhat high estimate. No counts for a whole year were available; it was assumed that for Summit County climatic conditions thirty times the weekly estimate would represent fairly the annual traffic. These weekly and annual estimates are given separately for trucks and passenger cars in Table V.

Dividing the estimated 30-weeks' tonnage by the traffic factor gave results varying from 30.1 in 1918, after about a year of freight-car shortage and embargoes, to 55.6 tons per unit of traffic factor in 1920, after three years of such obstacles to rail shipments. Passenger-car traffic ranged from 58.3 to 97.8 cars per unit of traffic factor on different roads and during different years.

As a measure of the precision of these relations, the table contains a comparison of the results with the normal law of error. Columns 9 and 14 show the square of the individual variations from the average of all the observations; and the last line indicates the probable error based both on the average variation and on the standard variation. It would hardly be expected that one-day counts during different business conditions and at different times of year expanded to a year's time would correlate closely; but we do find that the variations follow the normal law of error fairly well. It is possible that the average relation is no more than 15 per cent in error.

On the basis of the counts shown, then, the average annual Summit County intercity traffic on paved roads in passenger cars will be 70 times the traffic factor; the freight traffic, in tons, 45 times the factor; in trucks, 20 times; and that these figures are probably within 15 per cent of the true values.

With the traffic thus determined, there remain operating savings to be estimated and compared with construction costs. Distance, grades, rise and fall, curvature, grade crossings, hardness and smoothness, all affect tractive resistance, safe operating speeds, or both. All, except hardness and smoothness seem of minor importance in determining whether an improvement is or is not justified. For example, the reduction of one mile in distance justifies a maximum operating expenditure of 85c. to $2.20, depending upon whether the debt for this improvement is or is not to be amortized, for outlay per vehicle yearly, at a saving of 11c. per vehicle mile given by W. G. Harger, in *Engineering News-Record*, July 22, 1920, page 171.

The smaller figure assumes a ten-year amortization of capital outlay; the larger assumes the earning of interest on a permanent debt. In the same article, Mr. Harger presents figures indicating practically no operating savings in eliminating grades of 2 per cent or under. In ordinary highway improvement, material reduction in distance, or of long grades, except at great expenditure, is not often possible.

Vehicle operating economies due to improved road surfaces may be judged by combining two kinds of data, namely, observed operating results for different surfaces and the actual costs of operating over any one type.

Table VI shows tractive resistance, speed and gasoline consumption on a 2-ton truck test over four types of surface. This table gives a clue to two sorts of economies effected by improved surface. The per mile power demand varies; it seems reasonable that with this power demand variation, certain running expenses per mile will vary, such as gas-

TABLE VII. RELATIVE HAULING COSTS FOR EQUAL TONNAGE IN DIFFERENT TYPES OF ROADS

Item	Earth	Gravel	Macadam	Pavement
Operating cost per mile, proportional to gas used	100	80 3	60 9	50 5
Per diem charges per mile while traveling, proportional to speed	100	48 4	36 5	28 0
Per diem charge per mile while traveling 90% of time on earth road	100	53 6	42 8	35 2
Per diem charges per mile while traveling 80% of time on earth road	100	58 76	49 2	42 4
Per diem charges per mile while traveling 70% of time on earth road	100	63 9	55 6	49 6
Per diem charges per mile while traveling 60% of time on earth road	100	69 0	61 9	56 8
Per diem charges per mile while traveling 50% of time on earth road	100	74 2	68 2	64 0
Per diem charges per mile while traveling 40% of time on earth road	100	79 4	74 6	71 2
Per diem charges per mile while traveling 30% of time on earth road	100	84 5	80 9	78 4
Per diem charges per mile while traveling 20% of time on earth road	100	89 7	87 3	85 6
Per diem charges per mile while traveling 10% of time on earth road	100	94 8	93 6	92 8
Per diem charges per mile while traveling 0% of time on earth road	100	100	100	100

TABLE VIII. ESTIMATED LIMITS OF ECONOMIC EXPENDITURE FOR SMOOTH ROAD SURFACES BASED ON RELATIVE COSTS OF OPERATION SHOWN IN TABLE VII

Item	Earth	Gravel	Macadam	Pavement
Freight Service:				
Running expense in cents per ton-mile assumed at 60% of total operating cost on pavement and to vary with gas used	5 94	4 76	3 62	3 00
Per diem expense in cents per ton-mile at 40% of operating cost on pavement and varying inversely as speed	7 13	3 45	2 61	2 00
Total cost in cents per ton-mile to operate truck over different road surfaces, sum of lines 1 and 2	13 07	8 21	6 23	5 00
Gross saving in operating expense in cents per ton-mile by different road surface improvements		4 86	6 84	8 07
Outlay in 5% 10-year annuity serial bonds which would use up entire gross saving per ton-mile annually, in cents		37 6	52 8	62 4
Passenger Service:				
Total cost in cents per car-mile at 8c. on pavement and increasing in proportion to gas used per mile	15 85	12 73	9 68	8 00
Gross saving in cents per car-mile by different road surface improvements		3 12	6 17	7 85
Outlay in 5% 10-year annuity serial bonds which would use up entire gross saving per car-mile per year in cents		24 10	47 65	60 65

TABLE IX. SAVINGS TO INTER-CITY TRAFFIC FROM PAVED ROADS

Item	Gravel	Macadam	Pavement
Freight service: 45 times line 4 of Table VIII	$2 19	$3 08	$3 64
Passenger service: 70 times line 7 of Table VIII	2 19	4 32	5 50
Total annual saving per mile of improvement for each traffic factor unit	$4 38	$7 40	$9 14
Freight service: 45 times line 5 of Table VIII	16 90	23 74	28 05
Passenger Service: 70 times line 8 of Table VIII	16 90	33 36	42 50
Total outlay per mile of improvement justified for each unit of traffic factor	$33 80	$57 10	$70 56

oline consumption, oil, tires and depreciation. It has been assumed that these cost items will vary with the gasoline consumption, as indicated in the first line of Table VII.

But there is another type of cost, including driver, garaging, obsolescence, interest and insurance, which goes on whether the machine is running or not; this is designated as the per diem charge. While the machine is running such

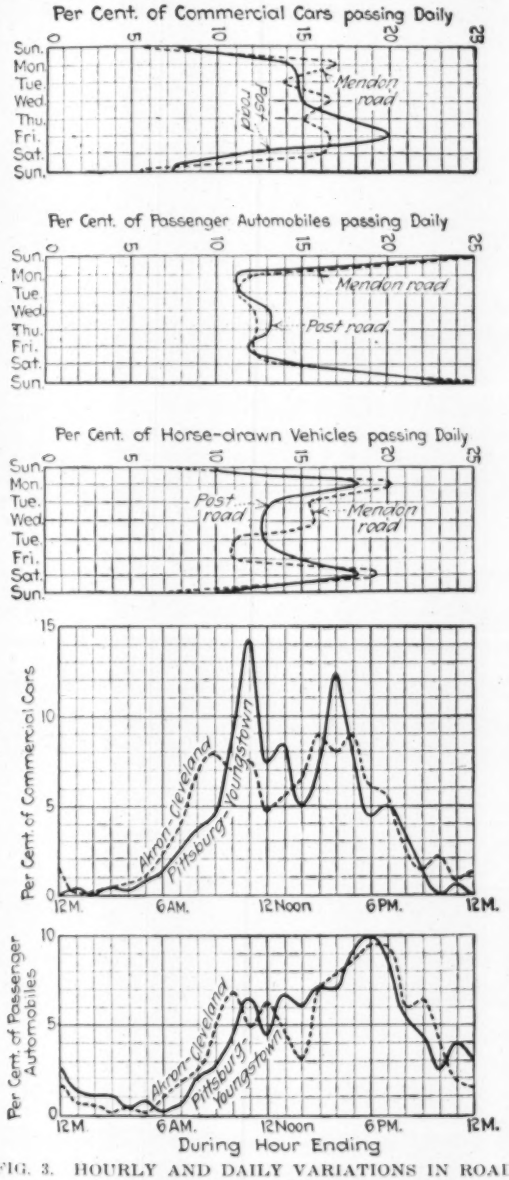


FIG. 3. HOURLY AND DAILY VARIATIONS IN ROAD TRAFFIC COUNTS

charges per mile will vary inversely as the speed. This latter saving cannot be entirely saved, however, unless standing time for loading and waiting for work is reduced in the same proportion. Table VII indicates the relative per diem charges per mile as speed rises on improved surfaces and as running time occupies more or less of the total working hours. While it may be too optimistic to hope that the full saving from increased speed will be obtained, line two of Table VII, which makes this assumption, is used for further computations.

The most efficient truck costs which the writer has found have varied between 4.2 and 6c. per ton-mile for pavement operation during a year's test. Five cents has been used as a base. Of this 5c., 3c. has been assumed as the total of the expenses which depend on power demand per mile; 2c. the total of the per diem items per mile, varying inversely as the speed. The gross savings from 5 to 8c. per ton-mile for gravel, macadam and pavement surfaces are shown in the fourth paragraph of Table VIII. The next line shows the maximum outlay in ten-year 5 per cent bonds one such saving each year will justify, varying from 38c. for gravel to 62c. for pavement. For passenger cars an average cost of 8c. a mile on pavement has been assumed; and, since passenger cars can ordinarily make reasonable speeds over most types of road surface, the power saving, proportional to line one of Table VII, has alone been applied. Gross savings from 3 to 8c. per car-mile are shown in paragraph 7, Table VIII. One of these savings a year will pay interest and principal on 24c. to 61c. in ten-year 5 per cent annuity bonds.

For convenience in computation Table IX applies the relation between the traffic factor and the savings and justified outlays of Table VIII, to determine savings and outlays as follows:

Improvements for inter-city traffic should be limited to from $34 to $70 a mile multiplied by the product of the populations in thousands of the centers connected and divided by the distance between them in miles; as inter-city traffic is a community benefit, none of the cost of providing for it should be specially assessed on abutting or adjacent property.

Maintenance

Obviously, the above figures are based on the false assumption that there will be no maintenance expense. Such expense will lower the allowable capital outlay. But maintenance costs do not yet seem sufficiently definite in terms of traffic and type of roadway to justify any attempt to reach the real economic solution, namely, the maximum excess of savings over costs, including operation, maintenance and capital charges, for any given traffic conditions.

What has been attempted is a separation of the sheep from the goats, the roads which may be profitable from those certainly not. For instance, the Cleveland-Hudson-Akron road apparently saves $41,500 a mile annually to through traffic alone; it originally cost less than $20,000 a mile which, with an appropriation of $8,000 a mile maintenance in 1920, makes its general physical failure of concern only as it interferes with traffic. There seems no fundamental objection to an enterprise which costs even $28,000 a year to taxpayers and returns $41,600 in general transportation savings. On the other hand, the recently let contract for a section of the Akron-Medina road at $57,000 a mile, with total capitalized savings to farmers and through traffic of less than $10,000 a mile, ought to cause worry.

Applying such an analysis to all the road improvements in Summit county, Ohio, it appears that one-half of the existing and proposed improvements, costing $2,106,000, effect savings which will pay interest and principal on $8,600,000 more than they cost; and that one-half, costing $2,063,000 will effect savings which will pay interest and principal on $1,157,000 less than they cost. While the county's results to date indicate a good profit from road improvement, it may be significant that the entire $1,114,650 program for 1921 construction shows a net loss of $708,000.

In other words, if these roads were built as toll roads, if farms along them contributed $25 an acre, if every passenger car paid eight cents a mile and every truck paid as much per ton-mile, if these tolls did not discourage any traffic, if there were no maintenance or administration expenses, if all these things were true, then the supposed toll company might be expected to fail for $708,000 when its ten-year five per cent bonds became due.

Conclusion

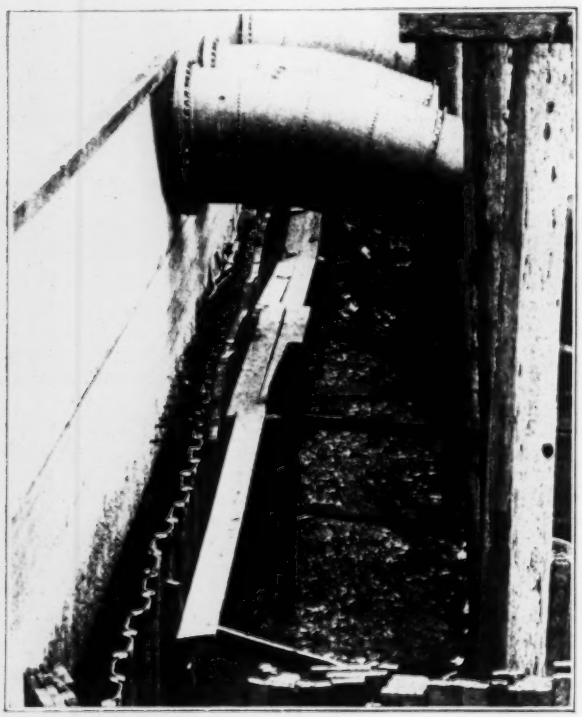
Apparently, there may be some very distinct limits to profitable road improvement expenditures. These limits may vary widely within a small section of the country. High authorities have recently declared that no one today has the necessary information to design a rational road improvement. Immense sums are being spent by states and even counties which have not yet learned to value adequate

engineering services and research as highly for public benefit as do contractors, material and equipment companies for private profit. Without reflection on the ability or efforts of highway authorities, these facts seem to indicate that highway design and construction methods today are not on that high plane which justify those expenditures for capital outlay for which fixed charges may approach the economic limit; and that, as a general policy, it may be better to build with a smaller outlay and to spend more for maintenance until such time as adequate records and better knowledge of traffic make certain the desirability of vast public investments.

Levee Settlement Causes Seepage Under Pump House

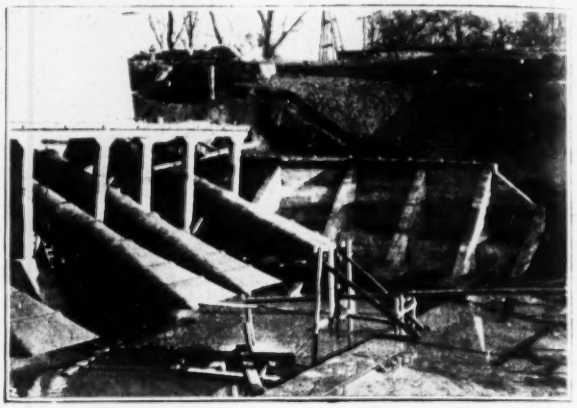
Cured by Driving Tight Row of Steel Sheetpiling Next to Pump House and Building Retaining Wall

A LARGE drainage pumping plant built in a levee on the Sacramento River in California was constructed with pump house, intake and discharge lines rigidly connected and each of these three structures supported on a separate pile foundation. As the levee consolidated with age the piles held the structures at the original level but the earth settled away from the under side of the



SHEET PILING ALONG REAR OF PUMP HOUSE
Note bolts, also depth of wash beneath bottom of concrete

concrete, and thus opened a channel in which river water came through the levee despite the concrete cutoff wall around the discharge lines. This seepage carried away earth under parts of the pump house to a depth of 2 ft. and caused caving in the earth embankments around the sump. Undermining of the foundations was considered a menace to the joints between pump house and the group of large concrete discharge lines because if one of these structures settled slightly the joint would be broken. A prompt and entire



SUMP SHOWING INTAKE PIPES AND PROTECTING WALL

stoppage of this seepage was therefore deemed necessary and was accomplished by driving a line of sheet piling which virtually brought the cutoff wall of the levee well toward the toe of the slope on the side away from the river. At the same time the bottom of the sump was paved with concrete and retaining walls were built around its sides to prevent further caving of the banks.

The pump house, which contains five 50-in. centrifugal pumps, direct connected to 600-hp. motors, is 42 x 106 ft. in plan and was designed to withstand a head of water 20 ft. above the floor of the plant. In order to give the structure sufficient weight so that it would not float when the water rose to this level walls and floors were made 6 to 7 ft. thick.

The pump house is supported on 24-ft. wood piles driven on 6-ft. centers, both ways, with a double row around the outside driven on 3-ft. centers. The foundation material is a combination of clay and sand with occasional layers of quicksand. The inner ends of the intake pipes which supply the pumps are bolted to the pump house wall, from which they extend about 40 ft. into the sump. About midway of their length these pipes are supported by iron rods slung from a cap across a row of concrete posts. Each pump discharges through a 60-in. reinforced-concrete pipe about 125 ft. long, these pipes being cast monolithic with the pump house structure. The discharge pipes are also supported on wood piles.

After the seepage was first noticed it increased gradually until, when repairs were being made, it required two 6-in. pumps delivering a total of about 5 sec.-ft. to remove water that came under the structure in this way. This seepage so loosened the banks around the sump that considerable caving resulted, one of the slides carrying away the end post in the row of posts supporting the intake pipes.

Partly because of the presence of quicksand, which made it a difficult foundation job at best, and partly because of the difficulty of getting an effective water cutoff around the concrete discharge pipes, it was considered best to stop the seepage by driving a line of sheet piling entirely across the landward side and both ends of the pump house and extending riverward to the levee axis. This made a total of 246 ft. for which interlocking steel piles were driven to a depth of about 30 ft. This plan had the advantage that it was unnecessary to make any water-tight joint around the discharge lines. The piles could be driven along the rear or landward

side of the pump house by simply unbolting the intake pipes from their flange connections on the pump house wall and swinging them back a few inches to allow the followers with which the piles were driven to work in between.

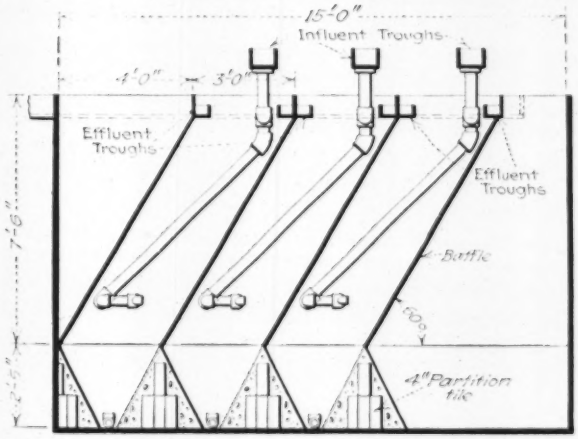
In order to attach the piling permanently to the pump house holes were drilled in the concrete, in which 48 x 1-in. bolts were placed and grouted with molten sulphur. The threaded ends of these bolts projected far enough to extend through holes in the sheet piles. After the piles had been bolted up in this manner the space between them and the pump house wall was filled with concrete to make a watertight seal.

Data for the foregoing was supplied by Fred H. Tibbetts, civil engineer of San Francisco, who had charge of the repair work.

Final Report on Waste Disposal of Chicago Stockyards

During Nine-Year Period of Study Activated Sludge Discovered—Early Decision Favoring Imhoff Tanks Revised

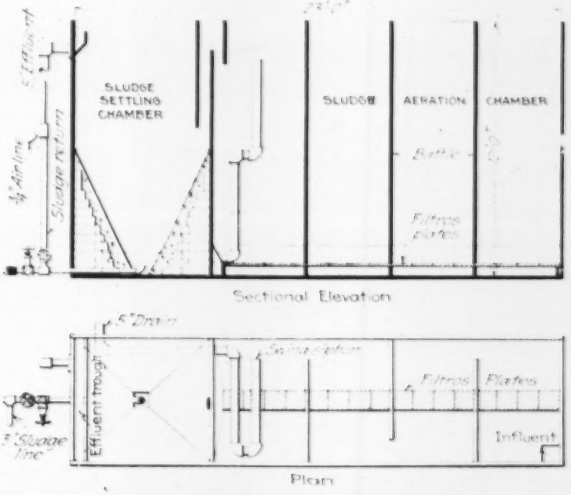
FOR nine years engineers and chemists of The Sanitary District of Chicago have been studying the sewage and sewerage conditions of the Chicago stockyards region. The wastes put an estimated load on the drainage canal equivalent to the sewage of 1,000,000 people. In 1914 a preliminary report stated that Imhoff tanks would solve the problem. Shortly thereafter the activated-sludge process was discovered and the present report indicates that this latter process, with the necessary preliminary and after treatment, will more nearly meet the requirements. The packers have offered to assume 60 per cent of the cost of a plant if the Sanitary District will pay the remainder.



INCLINED-BAFFLE VERTICAL-FLOW HOPPER BOTTOM SETTLING TANK

This offer is now under consideration. It is therefore possible that within a reasonable time Chicago will have one of the first activated-sludge plants yet constructed to handle industrial waste three to four times as strong as ordinary domestic sewage. In 1914, when the waste was strongest, the day sewage averaged as follows: Suspended solids, 281 to 506 p.p.m.; oxygen consumed, 150 to 269; fats, 80 to 191; bio-chemical oxygen consumed, 834 to 1477 p.p.m. In the night sewage the suspended solid content was 73 to 313 p.p.m.; fats, 12 to 134 parts.

The three methods of operation deemed available for the stockyards wastes are: (1) Sewage and sludge aërated together, (2) the sewage and sludge settled and re-aërated during its return to meet the incoming sewage, and (3) the sludge settled and re-aërated and the re-aërated sludge re-settled before its return to the incoming sewage. Only the first and



SLUDGE AERATION AND SETTLING TANK

third methods were experimented with. In summer under the first method a stability of over 50 could be secured with about 9 hr. aëration and 3½ cu.ft. of air per gallon of sewage. In colder weather lower stabilities, 10 to 38, were secured with 9 hr. aëration and 4 to 5 cu.ft. of air. Under the third method the aëration period was 5.3 hr. in the sewage tanks and 3.8 hr. in the re-aëration tank, the weighted average being equivalent to a 6.6-hr. period. Although showing a substantial saving in tank space, more settling space was required with re-aëration, the settling periods being 1.3 hr. with aëration and 1.7 hr. without re-aëration. The air consumption was 3.5 cu.ft. per gallon, about the same in both cases.

Although re-aëration effects a substantial saving in tank space, it increases the complexity of the process and necessitates more careful supervision, and it is on these accounts that the engineers are still doubtful whether re-aëration and re-settling are desirable in a working plant.

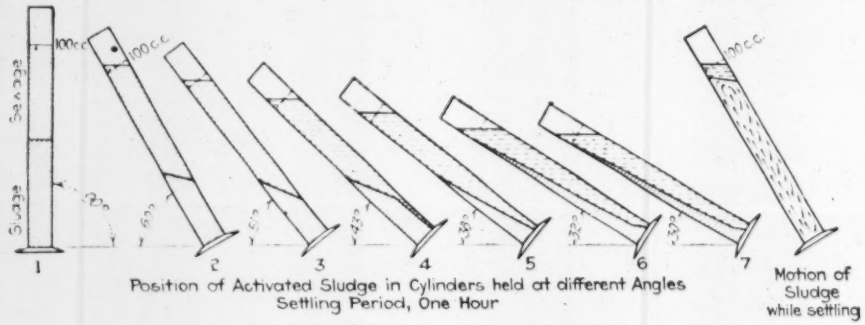
Another set of experiments on the first method was made under winter conditions without re-aëration of the sludge before return to the aëration tank. An average of 4.3 cu.ft. of air was used with an aëration period of 8 hr. The stabilities ranged from 41 to 71 per cent.

The quality of the effluent produced by the activated-sludge treatment was considered reasonable and the amount of air and tank space not excessive in view of the strength of the waste. Milwaukee results indicated that 4 to 5 hr. aëration with 1.5 cu.ft. of air is required for the sewage of that city which is about one-third the strength of packing-house waste.

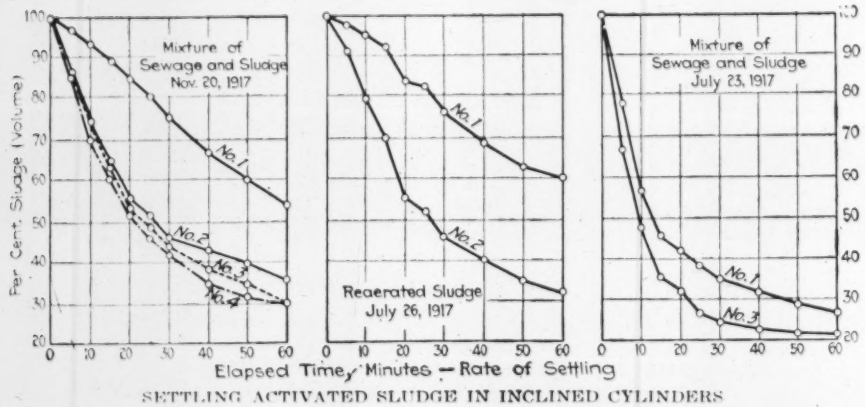
Screening the sewage through a 20- or 30-mesh screen before aëration was considered desirable to remove much comparatively inert coarse material which resists oxidation and might settle on the bottom of the tank unless an excessive amount of air were used to

keep it in suspension. Inasmuch as this material contains only 80 per cent moisture it would not require filter pressing.

In addition to about 400 lb. of dry screenings about 2,300 lb. of dry sludge was removed in the experimental tanks from each million gallons of waste. It contained 99 per cent of water. As the total flow of packing-house waste is 58 m. g. d., 162,400 gal. of wet sludge must be disposed of daily. By pressing through small filter presses for 3½ hr. under an ultimate pressure of 125 lb. the water content could be reduced to from 90 to 75 per cent. Adding 2 c.c. of sulphuric acid per gallon of sludge cut the time of pressing in half. No tests on drying the pressed sludge were made. Dry,



Position of Activated Sludge in Cylinders held at different Angles
Settling Period, One Hour


Per Cent. Sludge (Volume)
Mixture of Sewage and Sludge Nov. 20, 1917
Mixture of Sewage and Sludge July 23, 1917
Reaerated Sludge July 26, 1917
No. 1
No. 2
No. 3
No. 4
Elapsed Time, Minutes — Rate of Settling

SETTLING ACTIVATED SLUDGE IN INCLINED CYLINDERS

the sludge contains 4 to 5 per cent of nitrogen and 5 to 7 per cent of fats. Conclusions on some of the factors in more detail are as follows:

Sludge—Typical activated sludge from Packingtown is brown, settles quickly and leaves a distinct line of demarcation. The moisture content of the sludge in the aëration tanks after one-hour settling runs over 99 per cent.

TYPICAL ANALYSES OF PACKINGTOWN SLUDGES

Sludge	Sp.Gr.	Per Cent Moist.	Calculated to Dry Weight Per Cent Nitrogen	Volatile	Fixed	Ether Sol.
Activated	1 004	99 15	4 17	62 6	37 4	6 0
Imhoff	1 02	91 5	2 72	65	35	6 6
Dortmund, tank D	1 02	91 7	2 88	76	24	8 6
Dortmund, tank C	1 02	90 6	2 65	72	28	8 1
Acid treatment	1 02	92 5	3 07	74	26	18 8

Dewatering Experiment — In the dewatering experiment air-drying on sand beds was much more rapid with Imhoff than activated sludge. Lagooning was unsuccessful. The sludge settled to the bottom with the water on top. Concentration was effected only by evaporation; considerable odor developed.

Sludge was pressed successfully without the use of lime in a standard plate press. Tests were made with an 11-chambered plate press of the center-feed type, containing 12 corrugated plates, each with 225 sq.in. of filtering area. For the best results air pressure was built up as follows: At start, 15 lb. per sq.in.; at ½ hr., 60 lb.; at 1 hr., 100 lb.; at 2 hr., 140 lb. The time varied from 2 to 5 hr. but was materially shortened by providing a sludge that was well activated. The sludge experimented with ranged from 97.3 per cent moisture upward. The first 20 tests were made with a ¼-in. cake. Radial ribs were then added, which improved the hardness of the cake. Thicker cakes were less firm. A ¼-in. cake had a moisture content of 73.9 per cent and one of 1¼ in. 78.2 per cent.

Sulphuric acid, or acid cake in sufficient amount to neutralize the alkalinity of the sludge, improved the yield of the cake from 11.7 to 38.5 per cent, prevented decomposition of the sludge, reduced clogging of the filter cloths and increased the nitrogen content of the sludge from 0.72 to 2.88 per cent.

Cotton duck cloths gave as satisfactory results as linen. For the 52 tests two complete sets of cotton duck cloths were used. The addition of ribs increased the relative drainage area as compared to cake area. The improvement was pronounced on a ¼-in. cake, the yield being doubled.

Slopes in Tank Bottoms — In hopper bottom tanks slopes of 30 deg. with the horizontal were found insufficient. A 45-deg. slope was not entirely satisfactory, but 61 deg. was.

Filtros Plates—Tests showed that each filtros plate needs support on four sides in a sturdy box. A marked increase in air pressure equivalent to 3.2 ft. during the period April 23 to Nov. 14, 1917, was largely attributed to iron rust.

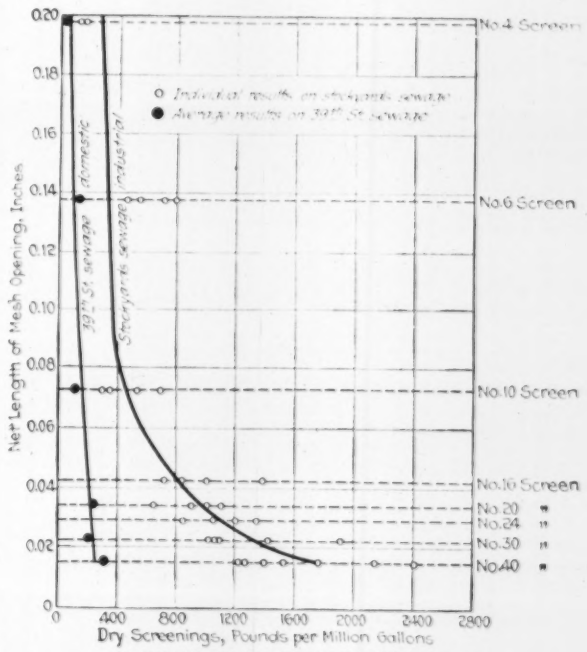
Screen Tests — A 30-mesh screen operated for 124 days recovered 858 lb. dry weight per million gallons from 6,000,000 gal. total passed. This was a reduction of 18.8 per cent of the total suspended matter. The 20-mesh screen operated 139 days, handled 5,000,000 gal. and recovered 368 lb. dry weight per million gallons, equivalent to 9.6 per cent of the total suspended matter. However, the crude sewage averaged 547 p.p.m. during the 30-mesh run against 460 p.p.m. during the 20-mesh run.

Acid Treatment—With a crude sewage made slightly acid with sulphuric acid somewhat better removal of suspended matter, 70 per cent, is obtained than by plain sedimentation. Scum formed slowly and was small compared to plain sedimentation in Dortmund tanks. The accumulation of sludge and scum for the Dortmund tank C was 5.8 cu.yd. per million gallons; for Dortmund tank D, 9.6 cu.yd.; for the Imhoff tank 8.1 cu.yd.; for chemical precipitation, 12.7 cu.yd., and for the acid treatment, 7.8 cu.yd. The acid sludge is somewhat higher in nitrogen than Imhoff or plain settling sludge and is highest of all the sludges in ether soluble matter. It was foul in odor, drying much less rapidly on a sand bed than Imhoff sludge.

Imhoff Tank — Conclusions from the operation of a 9-ft. diameter, 17-ft. depth Imhoff tank for six years are that higher reductions are obtained from a horizontal flow than with a vertical flow. Suspended matter removed by upward velocities, ranging from 1.9 ft. to 5 ft. per hour with corresponding detention periods of 4 hr. and 1.5 hr., were 45 and 50 per cent reduction respectively. Horizontal velocities of 12.5, 9.2 and 6.0 ft. per hour with detention periods of 1.4, 1.9 and 2.9 hr. gave 42, 59 and 57 per cent reductions respectively. The ebullition of gas from the sludge chamber was continuous. Although generally inoffensive, hydrogen sulphide was sometimes noted. Scum was nearly always

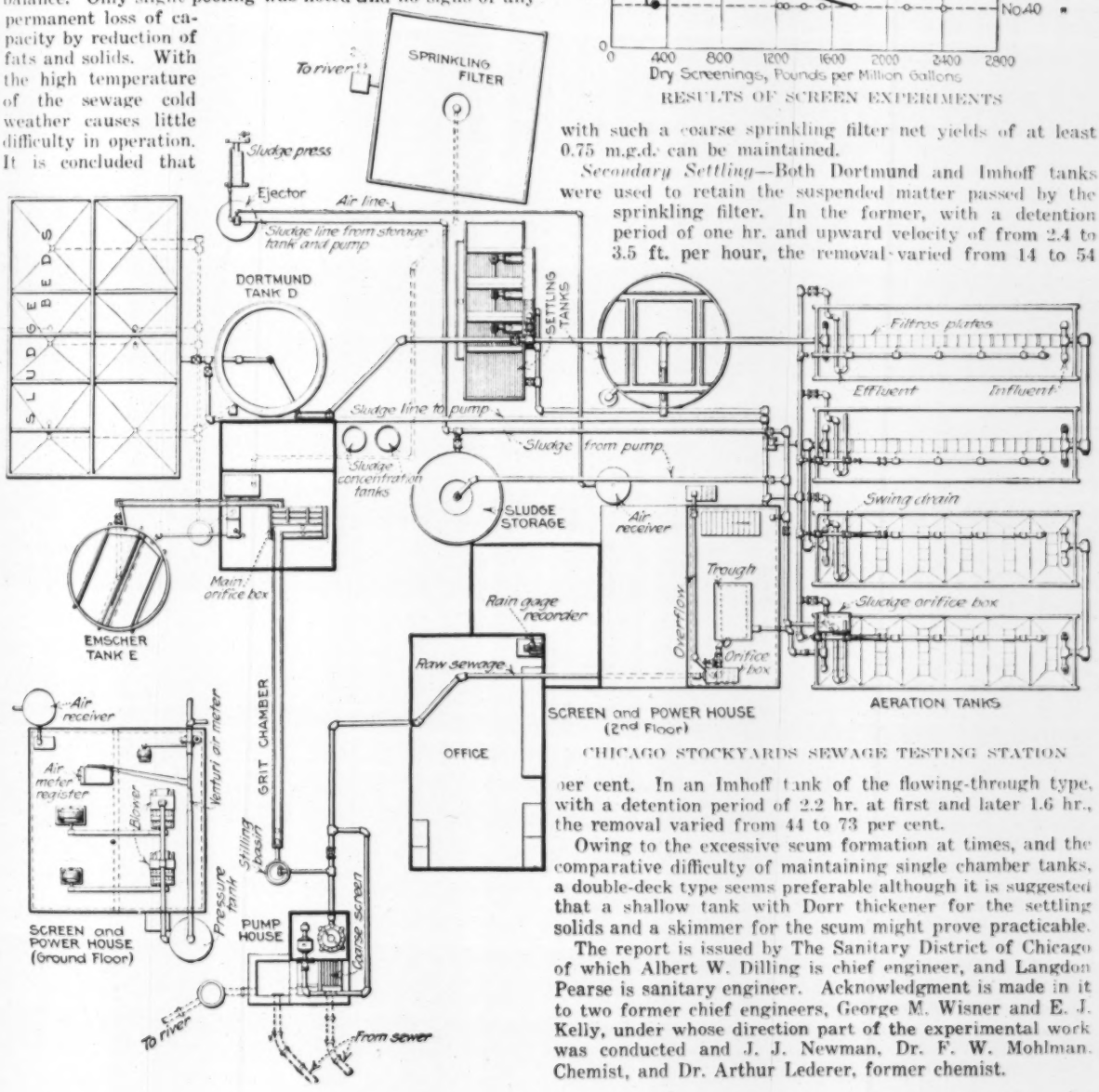
present on the gas vent surface. A thin grease scum persisted on the surface of the settling chamber and was removed at the rate of 0.4 cu.yd. per million gallons. The sludge was uniformly black or dark gray in color, flowed freely and drained readily on the drying beds to a spadable condition in summer in 4 to 7 days, and in winter under glass in 4 to 5 days.

Sprinkling Filter—Four years' operation of a sprinkling filter 6 ft. in depth, consisting of 3½ ft. of 1½ to 2 in. limestone overlying 6 in. of 2 to 4-in. stone, receiving the effluent from the Imhoff tank was satisfactory. It was dosed with a Taylor circular spray nozzle with a cam device for regulating the head. Rates (actual net yields) were 0.786, 0.987, 1.313 and 0.965 m.g.d. Suspended matter applied varied from 43 to 340 p.p.m. and the removal ranged from 48 to 63 per cent. Nitrates in the effluent varied from 5.3 to 34 p.p.m. An average relative stability for the whole period was 68.7; with high rates in the winter it ranged from 18 to 29 and with low rates in the winter from 24 to 74. During the summer it ranged from 61 to 98 with one month only at 40. The performance was best emphasized by the reduction in dissolved oxygen requirements; 990 p.p.m. was required for complete stabilization for the crude sewage, whereas the filter effluent was 137, a reduction of 87 per cent for the tank and filter. Unloading maintained a balance. Only slight pooling was noted and no signs of any permanent loss of capacity by reduction of fats and solids. With the high temperature of the sewage cold weather causes little difficulty in operation. It is concluded that with such a coarse sprinkling filter net yields of at least 0.75 m.g.d. can be maintained.



RESULTS OF SCREEN EXPERIMENTS

Secondary Settling—Both Dortmund and Imhoff tanks were used to retain the suspended matter passed by the sprinkling filter. In the former, with a detention period of one hr. and upward velocity of from 2.4 to 3.5 ft. per hour, the removal varied from 14 to 54 per cent. In an Imhoff tank of the flowing-through type, with a detention period of 2.2 hr. at first and later 1.6 hr., the removal varied from 44 to 73 per cent.



CHICAGO STOCKYARDS SEWAGE TESTING STATION

Owing to the excessive scum formation at times, and the comparative difficulty of maintaining single chamber tanks, a double-deck type seems preferable although it is suggested that a shallow tank with Dorr thickener for the settling solids and a skimmer for the scum might prove practicable.

The report is issued by The Sanitary District of Chicago of which Albert W. Dilling is chief engineer, and Langdon Pearse is sanitary engineer. Acknowledgment is made in it to two former chief engineers, George M. Wisner and E. J. Kelly, under whose direction part of the experimental work was conducted and J. J. Newman, Dr. F. W. Mohlman, Chemist, and Dr. Arthur Lederer, former chemist.

An Analysis of the Current Valuation Report on the Kansas City Southern Properties

Status of Investigation to Date—Present Announcement of Interstate Commerce Commission Includes Single Sums as "Value" But No Statement of Method—Land Acquisition Costs Apparently Disallowed

By Samuel W. Moore
General Counsel, The Kansas City Southern Railway Co., New York

On a few occasions, the pages of this journal have carried articles written by prominent members of the legal profession and bearing on subjects in which engineering plays a leading rôle. Judge Moore's contribution, written especially for Engineering News-Record at the request of the editors, is notable as an authoritative analysis of the more important questions at issue in the federal valuation of the railroads of the United States. With the issuance, April 5, 1921, of "supplemental" valuation reports, including additional costs of acquiring lands, as required by the Supreme Court decision in the Kansas City Southern case a year ago, there is reason to believe that the valuation of this property will continue as a test case of final methods to be employed. Judge Moore's connection with the case dates from its inception and it was he who finally secured a favorable decision from the Supreme Court even after many railroad men, in light of the Minnesota rate case decision, had discouraged the project of compelling the Interstate Commerce Commission to find and report separately additional costs of acquiring carrier lands. This article brings the discussion up to date and includes a clear, well measured statement of the railroads' viewpoint. Discussion of the subject at this time, previous to formal hearings before the Interstate Commerce Commission as a whole, is thought proper since at this stage of progress the matter is considered in the nature of an investigation rather than a "case." It appears that the investigation is far from completed.—Editor.

FOUR "supplemental tentative valuations" were announced by Division 1 of the Interstate Commerce Commission, April 5, 1921, in the cases of the Kansas City Southern, the Los Angeles & Salt Lake, the Atlanta, Birmingham & Atlantic, and the Winston-Salem Southbound, marking the most recent, if not the final action of the commission in the valuation of those properties. A statement summarizing these reports appeared in the *Engineering News-Record*, April 21, 1921. For each of these roads, the commission, through Division 1 (which for convenience will be referred to as the commission), has fixed a single sum as the tentative final figure of value. These single sum values, as their name indicates, are tentative only, and the companies are entitled again to file their protests and to have further hearings before the commission, at which they may urge that values of their properties should be greater than those made in the reports. It is only after these protests shall have been heard by the commission, and disposed of, that its single sum figures of value, whatever they may then be, will become final.

It is generally assumed by those interested in valuation work that the Kansas City Southern has been selected by the commission as a test case, or as one of several test cases, for the purpose of trying out the act for the valuation of railroads. What follows, therefore, is an analysis of the valuation proceedings in so far as they affect that road and with particular respect to the current "supplemental" report.

The supplemental tentative valuation deals with two subjects: First, single figures of value assigned to the Kansas City Southern proper, and separately for its subsidiary companies, and, second, the so-called excess cost of acquisition of lands. These two matters are considered separately and in the order named.

No single figure of value has been stated for the Kansas City Southern as a system. The company had asked that this be done, for the reason that Section 422 of the Transportation Act, 1920, providing for the disposition of earnings in excess of 6 per cent of the value of railway property held and used for the service of transportation, provides that the value of railway property and the net operating income of a group of carriers, "which the Commission finds are under common control or management and are operated as a single system, shall be computed for the system as a whole irrespective of the separate ownership and accounting returns of the various parts of such system." It would seem necessary that system values should be established, and doubtless this will ultimately be done.

The single figures of value for the Kansas City Southern, and separately for each of its constituent lines, as nearly as they can be ascertained from the commission's report, are as follows:

Kansas City Southern Ry	$30,086,595
Texarkana & Fort Smith	8,077,191
Kansas City, Shreveport & Gulf	8,725,737
Port Arthur Canal & Dock	1,927,309
Maywood & Sugar Creek	34,000
Ft. Smith & Van Buren	47,000
Poteau Valley	94,068
Arkansas Western	343,228
Kansas City, Shreveport & Gulf Terminal	150,779
Total	$49,485,907

The first thoughts that suggest themselves are: Do these figures represent the deliberate judgment of the commission? Has it definitely determined how railway property shall be valued? Has it decided that there is one value for all purposes, or different values for different purposes? Has it formulated the rules, principles, processes and methods of railroad valuation?

It seems highly probable that these questions must be answered in the negative, for the following reasons: The first tentative valuation of the Kansas City Southern was issued by the commission in 1916. It stated no single sum value. A protest was filed; thousands of pages of testimony were taken, and the case argued and submitted to the commission in 1918. A decision was

handed down, dated July 1, 1919, not giving any single sum figure of value, but confined entirely to statements of original cost to date, cost of reproduction new, cost of reproduction less depreciation, and lands. The report of the commission is contained in *Valuation Reports*, 1, pages 223-442. Commissioners Hall and Daniels dissented, and Commissioners Aitchison and Eastman did not participate in the disposition of the case. The commission, as soon as the President shall have completed the appointment of four new members, will consist of eleven commissioners, and there will then be upon the commission but three out of the eleven who voted for the decision of July 1, 1919. Of the remaining eight members, four will be newly appointed members who have not participated in any of the previous hearings, and of the remaining four, two did not sit, and two dissented at the previous hearing. Division 1, which issued the recent report, is composed of Commissioners McChord, Aitchison and Meyer, and of these three it may be assumed that Mr. Commissioner Aitchison did not participate, since he did not participate at the previous hearing. This apparently leads to the inference that the recent report reflects the views of but two members of the entire commission. It is hardly to be supposed that the commission would assume the tremendous responsibility of deciding upon the rules and principles which are to govern the valuation of the vast railroad property in this country without the fullest consideration by the entire commission as finally constituted and reorganized after the four new appointments.

Single Sums as "Value"

So far the commission has not at any time made any announcement whatsoever of the kind of value it is to find, or the rules for its determination. In the hearings and arguments thus far had before the commission, in the numerous briefs that have been filed and in the articles and books that have been written, the greatest confusion prevails upon this subject. For several years it was maintained, and argued to the commission on several occasions, that the commission was not required to find a single sum of value, but only to ascertain for each carrier its cost to date, its cost of reproduction new, its depreciation and the value of its lands, thus leaving to the court or commission, whenever the subject should come up, the duty of fixing its own single sum of value. But in the Texas Midland case, decided June 1, 1918, the commission determined that it was authorized to find a single sum as the value of the property for purposes under the act to regulate commerce, although it was questionable in its mind whether it was required to do so. It is said:

> While it may be questioned whether or not the act requires the finding of a single sum as the value of the property, we are of the opinion that it authorizes the finding of such value for purposes under the act to regulate commerce, and it is our purpose utlimately to make such a finding as to each property.

What is value "for purposes under the act to regulate commerce"? Is it value in the ordinary and usual sense of the word, or is it a "rate base," in the sense of an arbitrary figure to be used in the making of rates? Is it value in the commercial sense, sometimes called exchange value or pecuniary value? Is there one value for rate-making purposes, another for purposes of condemnation or consolidation, another for purposes of recapture of excess earnings, another for purposes of taxation; or is there, as the carriers contend, but one true value for all purposes? These questions have all been exhaustively presented to the commission. They are now pending before it, and must soon be determined.

While the commission has remained silent upon this all-important subject, its director of valuation, Hon. C. A. Prouty, has prepared a formula for the valuation of railroad property, and in January, 1920, at a public hearing, he urged the commission to adopt it. This recommendation from the director of valuation is highly important, not only because of his close relation to the commission, but because of his great familiarity with the railroad problem, and most important of all, his thorough appreciation of the difficulties which it presents and the grave responsibility which it imposes upon the commission.

Would Not Consider Commercial Value

Judge Prouty's recommendation is that the commission do not attempt or undertake to find value in its economic or commercial sense. His conception of the value required by the Valuation Act is an equitable sum to be determined for each carrier, resting in the discretion of the commission, and considered and deemed by it a fair and equitable amount upon which the carrier should be permitted to earn a fair return. In his printed Memorandum Upon Final Value (page 2), above referred to, he says:

> In a memorandum filed with the commission upon the first valuation hearing I stated that this value to be fixed by the commission was not the exchange or condemnation value, so called, but was rather that sum upon which, giving due consideration to all relevant facts, a fair return ought to be allowed. Nothing which has transpired in all the elaborate discussions then and since has in anywise tended to alter that opinion.

For this "sum" there is no known standard or measure. It bears no relation to commercial or pecuniary value. In fact, Judge Prouty entirely rejects commercial value, and in rejecting it, says (page 5): "I can not believe that this kind of going value can be at all considered by you in finding the rate-making value for which you are in search."

Formula Proposed by Director Prouty

Judge Prouty then proceeds to state his formula for determining the value that he recommends be found by the commission, starting with cost of reproduction less depreciation as the basis of computation. The formula adds an element of value known as "going value" which attaches to the property itself and "is the same whether the exchange value of that property is great or small." It also adds appreciation as an element of value, for the reason that "it is universally admitted that an old and seasoned roadbed is worth more for the transaction of business than a new one." The director then proceeds to a consideration of the proper measure of appreciation and going concern value, and reaches the rather surprising conclusion (page 10) that the aggregate of these two elements is "some 7 or 8 per cent of the cost of reproducing the road, including general expenditure but excluding land," and that "that sum should be added to the depreciated cost of the property in reaching its value." In practice he takes the average of these two figures—7½ per cent of the cost of reproducing the road—and adds that to cost of reproduction less depreciation, and to this sum he adds "present value" of lands, materials and supplies, and working capital, and

the result is given as the value of the road. In order to illustrate his formula he takes as a concrete illustration the Texas Midland Railroad, and computes its value as follows (page 10):

Cost of reproduction, less depreciation	$2,597,389
Add 7½ per cent of cost of road, new, including general expenditures excluding land	214,025
Present value of lands	254,759
Materials and supplies	96,875
Working capital	60,000
Total	$3,223,038

Judge Prouty concludes that a valuation of the Texas Midland at $3,225,000 would be a fair value upon which to permit the owners of that property to earn a return, and expresses his conclusion in the following language (pages 10-11):

> For my own part, considering the history of the Texas Midland, I am satisfied, from an examination of the whole matter, that something in the vicinity of $3,225,000 would be a fair value upon which to permit the owners of this property to earn. That value includes materials and supplies and working capital. The materials and supplies are stated at the amount actually on hand upon the date of valuation. Ordinarily this figure can probably be accepted.

This does not profess to be the pecuniary or economic value of the Texas Midland. It would scarcely be claimed that the road could be sold at that sum, or anywhere near it, or that if the Government condemned the road for the purpose of consolidating it with some other railroad, it would be required to pay this sum, or anything near it. It may be an equitable "sum" or a rate base. Certainly it does not pretend to be value in the commercial sense.

Formula Evidently Used in the Current Report

Coming, now, to the supplemental tentative valuation of the Kansas City Southern, it is apparent that while the commission has not seen proper at this time to disclose the method by which it has arrived at the sum of $49,485,907, in the aggregate (which has been found to be value, "as that term is used in the Interstate Commerce Act"), it seems highly probable that Judge Prouty's formula has been employed. It is greatly to be regretted that there has been no disclosure by the commission of the processes employed, in view of the fact that the Valuation Act requires it to state "an analysis of the methods of valuation" employed. The commission, however, appears also to have followed the recommendation of Judge Prouty in his memorandum (page 9), where he says: "The commission is under no obligation to state the mental processes by which it arrives at that conclusion, nor does it seem to me that it should attempt to do so."

The commission's final revision of the figures showing cost of reproduction new and the cost of reproduction less depreciation has not been made public. Approximating these figures as nearly as possible, it seems highly probable, however, that the commission, following Judge Prouty's formula, has taken, for each carrier, the cost of reproduction less depreciation as the base, and has added to it (a) about 7½ per cent of cost of reproduction of the road accounts (excluding land and equipment), (b) the so-called present value of lands (not including excess cost of acquisition), (c) materials and supplies and working capital, together with (d) the cost of the Port Arthur Ship Canal. The aggregate of these items is evidently stated as the tentative final single sum figures of value, for each of the carriers constituting the Kansas City Southern System.

There are a number of significant conclusions to be drawn from these figures. They do not purport to be the commercial or economic value of the properties. No one would for a moment contend that they could be bought or condemned for any such sum. It is apparent that no consideration has been given to their earning power. The company has heretofore insisted before the commission, and still insists, in the language of the Supreme Court of the United States (Branson v. Bush, 251 U. S., 181), that the value of its properties results from the use to which they are put, and varies with the profitableness of that use, present and prospective, actual and anticipated. On that basis it has submitted evidence to the commission that the value of its properties, on June 30, 1914, was somewhere between $75,000,000 and $80,000,000.

Land Costs Apparently Disallowed

The formula of value apparently employed by the commission makes value largely dependent upon estimated cost of reproduction and depreciation figures. A dollar of estimated cost in a bankrupt road is given the same value "as that term is used in the Interstate Commerce Act" as a dollar of cost in the most prosperous road in the country. This value, it should be remembered, is to be used for the purpose of the consolidation of roads, for the issue of securities and for the recapture of excess earnings, as well as for the purpose of rate making. It may be noted in passing that in the Grand Trunk arbitration, two out of the three arbitrators have very recently decided that the value of that system was to be determined by its earning power under reasonable rates, and that evidence of its cost of reproduction was not even admissible.

It is further apparent that nothing has been allowed for the so-called excess cost of acquisition of land, which the commission has computed in response to the Kansas City Southern mandamus suit, decided by the Supreme Court of the United States on March 8, 1920. The aggregate amount of such excess cost of acquisition of land, stated for the first time in the supplemental tentative valuation of April 5, 1921, and apparently disallowed in the figures of final value, is $4,371,970. The so-called present value of the company's lands which apparently has been included in the final figures is stated at $4,609,377. The aggregate of these two amounts, which represents the estimated total cost of acquisition of the company's carrier lands as of June 30, 1914, is $8,981,347.

It is of the highest importance that a clear understanding be had of the so-called "present value" and "cost of acquisition" of lands. The impression has been created in some quarters that the commission has allowed the railroad companies the "present value" of their lands, but that they are not satisfied with that allowance and insist upon having something additional, called "excess" cost of acquisition.

The so-called "present value" is not present value at all. The use of the expression is highly misleading. If it were true that the carriers had been allowed the real present value of their lands, they would be entirely satisfied with it, and would not be asking for something in addition. The so-called present value is determined by taking the average market value of adjoining land and applying it to the area of the right of way. The cost of acquisition is an estimate of what it would cost, as of valuation date, to acquire the right of way by purchase or condemnation.

The meaning of these expressions will be made clear by an illustration. The railway company, let us assume, desires to acquire a strip of right of way 100 ft. wide and containing 5 acres, running diagonally through a farm of 160 acres, the average value of the entire farm being $300 per acre. The 5 acres of right of way multiplied by $300, the average market price per acre, gives $1,500, which the commission calls the "present value" of the right of way. But every one with the slightest experience knows that to acquire a 100-ft. strip of right of way through a 160-acre farm would cost much more than the average market value per acre of the entire farm.

There would be consequential damages to pay, resulting from the damage to that part of the farm remaining after the right of way strip was taken out. In the case supposed, it would cost not less, let us assume, than $3,000, or double the so-called present value, to actually acquire the strip of right of way by purchase or condemnation. The real present value would be what it would cost to acquire the right of way, or to acquire an adjacent right of way of equal value, and that cost, in the case supposed, would be $3,000. The cost of acquisition would be $3,000; the so-called present value would be $1,500, and the so-called excess cost of acquisition would be the amount by which the cost of acquisition exceeded the so-called present value, which would be $1,500.

The cost of acquisition of lands is only another and more appropriate name for cost of reproduction of lands. Cost of reproduction, whether of physical property or of lands, is a recognized element or factor in determining value. The commission has apparently included in its formula the cost of reproduction of rails, ties and other physical property, but has declined to include the cost of reproduction of lands.

"Kind" of Value Must Still Be Determined

While it is probable that this most recent tentative valuation of the Kansas City Southern does not represent the deliberate and considered judgment of the commission and should be regarded only as an additional step in the development of this most important subject, it is, nevertheless, manifest that its outstanding feature is that a purely physical valuation, on a basis of estimated cost, appears to have received the commission's approval.

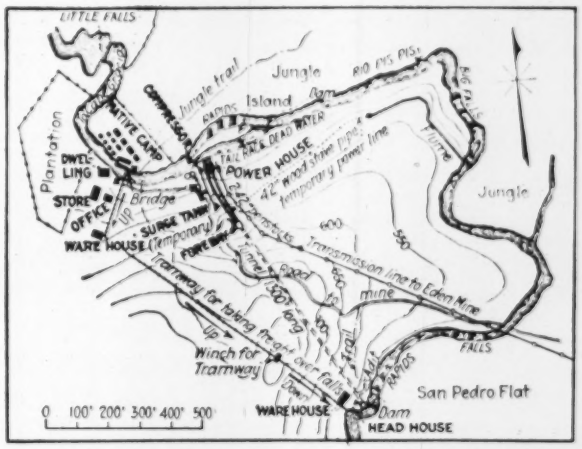
Apparently the cost of reproduction of carrier lands is to be ignored in so far as it exceeds the so-called present value; the earning power of the road is to be disregarded, and bankrupt roads and prosperous roads are to be valued, in the main, in proportion to their estimated reproduction costs. This process may be appropriate for the fixing of a "rate base," to be used in the determination of reasonable rates. But the law as it stands requires the commission to determine a value which shall be used for the purpose of consolidation of railroads, and this clearly means a commercial or economic value, or, as it is sometimes called, an exchange value. The law also requires the commission to determine value for the purpose of recapture of excess earnings, and this contemplates the same kind of value, that is, the value which the Constitution protects against confiscation. The real problem before the commission is to decide what kind of value it is to find, and how it shall be determined, and its solution of this problem remains incomplete.

Tunnel Building in Nicaraguan Jungles

Natives Expert Boatmen and Adepts with Broad Axe and Adze — Many Local Woods Suitable for Construction Work

By H. L. Thackwell
Engineer, Denver, Col.

TUNNEL construction with native labor, in building, during the last years of the world war, a hydroelectric plant in the interior of Nicaragua taught the writer the advisability of letting piece-work contracts for all operations which cannot be supervised personally. Incidentally the pioneer heading method was shown to be practicable and highly economical in driving a tunnel of small cross-section. These facts, with the knowledge gained of managing native workmen and of the utility of native timbers for construction purposes, rounded out a jungle experience in engineering which may be useful to others required to undertake operations in the interior of Central America.



HYDRO-ELECTRIC PLANT AT THE BIG FALLS OF THE RIO PIS PIS, NICARAGUA

As indicated by the map, Fig. 1, the location of the power development was at the Big Falls of the Rio Pis Pis, which are about 150 miles inland from the Atlantic coast and about 60 miles south of the Honduranian border. All supplies were freighted up the river in dugout canoes, locally called pit-pans. The Indian canoe men were remarkably adept at handling heavy freight in the swollen torrents, and over dangerous rapids and the average time for a loaded canoe to make the trip from the coast to the falls was ten days.

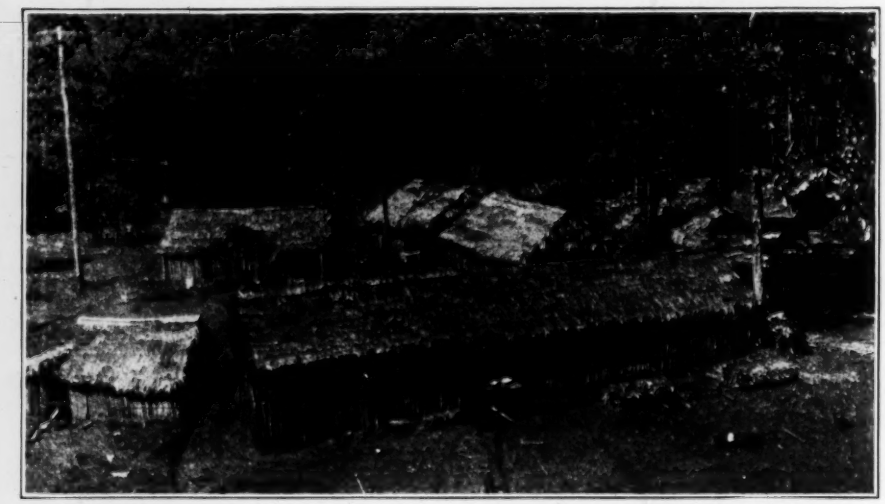
Part of the work comprised the driving of a tunnel some 1,300 ft. long, through which a portion of the Pis Pis River was to be diverted for power purposes. On account of the war machinery was difficult to obtain on short notice, so it was decided to commence immediately driving the tunnel by hand. Months later a compressor was obtained, which, driven by a 50 hp. Pelton wheel, furnished sufficient compressed air for the operation of two Leyner-Ingersol rock drills, and one Jackhamer drill.

A cross-section of the tunnel is given in Fig. 2. In plan, the only part requiring explanation is the adit at the river end. This was driven to give access to the workings when the river end was closed to keep out the river.

Tunneling Methods.—Using hand drills the first plan was to drive the full section. However, the rock, an altered andesite seamed with kaolin, would fall when least expected so that it was dangerous to drive more than 5 ft. without timbering. This necessity for timbering close to the face cut down the advance to 2 ft. a day at each heading. Finally the plan was adopted of driving a small pioneer heading and enlarging it to full section. Several advantages resulted.

On account of the small dimensions of the advance tunnel, 4 x 5½ ft., no timbering was necessary, and the chief cause of the previous delay was avoided. The rate of the advance made by the pioneer section was greater than that of the larger section, and in consequence the tunnel was holed through months ahead of the time required to make a connection of the full sized headings. As soon as the pioneer headings met, proper ventilation was obtained, and more important than that, drainage was established through the tunnel thus abolishing the expensive pumping system required for the upstream heading. Moreover, as the pioneer section advanced, miners working in the rear could drill holes into the sides and roof of the tunnel and blast out the sidewalls and roof as desired. The efficiency of a charge

SECTION OF PENSTOCK TUNNEL


CONSTRUCTION CAMP IN NICARAGUAN JUNGLE

powder exploded in this manner was far greater than an equivalent charge in the face of the bore. By this procedure an average full section advance of 3 ft. per day was made; the pioneer advance varied from 3 to 5 ft. per day in each heading.

At first an attempt was made to work three shifts of 8 hr. each. This was soon abandoned when it was found that it took from ¾ to 1½ hr. to allow the smoky atmosphere to clear sufficiently, so the men could work at the face of the heading. The most rapid progress was made by letting contracts to native miners, one contractor taking the upper heading and the other the lower. The term contractor, as here used, is more or less misleading, when one thinks of contracts as made and kept in the United States.

The native contractor is generally a penniless and irresponsible miner who agrees to drive the bore for so much a foot. The company sells him powder, fuse, caps, candles, etc., at a fixed price. Should the contractor find that he is losing money, he is likely to stop his work the week after signing the contract. Since he is not under bond, nothing can be done to hold him to his agreement and new terms have to be agreed on. On the other hand if he should be striking it rich the company is in honor bound not to change the contract price until the end of the term, which in this particular case was generally placed at one month. At the end of the month after measurements had been made and the contractor paid up, a new agreement was made, based on the progress of the previous month, and on the nature of the rock encountered in the heading. The best results were obtained by letting a contract at a fair price per foot, and also promising a bonus of so much a foot for each foot over a specified advance made during the month. It was found that No. 8 X detonators gave the best results in blasting. Hercules dynamite of 40 per cent and 60 per cent strength was used throughout the work.

Labor and Laborers — In Nicaragua the laborers are of several races, and, in numbers, predominate in the following order: Nicaraguans, Mosquito and Suma Indians, Honduranians, Jamaicans, Costa Ricans and a scattering of Chinese. Day labor receives about $1.50 per day while skilled drillers and carpenters get from $2 to $3 per day. Blacksmiths and machinists are the highest paid workers; some of them receive as high as $4 per day.

With the contract method several days were lost reorganizing the crews, at the end of each month. Meanwhile the money obtained in wages by the workmen would be gloriously spent in a couple of days, in drunken orgies at the native mining villages, or else at the gaming tables of professional gamblers.

The Nicaraguans, proverbially careless in regard to the handling of explosives, seem to have been protected by a gracious Providence in this work, for although tons of explosives were used on the tunnel, dam-site and other work, there were no accidents. The natives always crimped the caps with their teeth, lit the fuse with burning sticks of dynamite, and tamped powder with anything that happened to be handy. In the Nicaraguan mining code provisions are made for the safety of miners as regards ventilation, timbering, etc. One provision of paradoxical nature reads as follows: "In the preparation of the shots (that is to say, the ramming of the powder in the drilled holes) only ramrods, the outside surfaces of which are of soft iron, bronze or other metals which do not produce sparks, shall be used."

The indifference with which the natives regard life is simply appalling. For instance some bull-packers were unloading dynamite from the backs of their panting beasts. They deliberately allowed the cases of 60 per cent dynamite to fall from the backs of the bulls to the ground. When warned of the danger of such a method of handling high explosives, they shrugged their shoulders and said, "Ah! Senor, and what do we care for living anyway."

Usually Nicaraguans are not as efficient as the Mexican or Chilean miners, but this is not to be wondered at, when one considers the enervating climate, and the chronic malarial affections of the majority of the workers.

Never employ Jamaican negroes on any work, with the possible exception of that of house-boy or groom. They are generally lazy, insolent, and ask for more favors than all the other natives together. Indians are unexcelled on river work, and in the handling of heavy freight; also, when given tasks, they do well at clearing land. The stronger Indians make good car-runners and shovelers.

Native Nicaraguans are the best miners, but it is well to discriminate between the good and bad. Dark skinned workmen are better and generally healthier than those of lighter hue. Don't employ English-speaking Nicaraguans, except as timekeepers, clerks, etc. As soon as a native learns English he forgets how to work. Avoid working Costa Ricans, Nicaraguans, and Hondurians together. Don't hire men who are loaded with malaria germs and who show obvious spleenic enlargement. Those suffering from chronic malaria simply act as media for the anopholes mosquito to infect the whole camp. Chinese make the best cooks for the "white mess," while native Nicaraguan women will cook and season the food more to the taste of the natives.

Make it a point to get rid of gamblers and agitators just as soon as they are observed. It is well to make an example of the more prominent boot-leggers, and other disturbers. When discovered in camp such men should be immediately arrested, and either thrown into jail or heavily fined.

Try to contract all work that cannot be personally supervised, such as timbering operations in the jungle, and night shift work in tunnels.

Native Woods Excellent for Construction.—The natives are adept at broad-axe and adze work in hewing and shaping of mine timbers. The following is a list of the more important native woods which are much used for mine timbers and for general construction work: Come-Negro, Granadilla, Binbayan, Santa Maria, Leche Amarilla, Nancita, Cortez, Pronto Alivio, Laurel (Greenheart), Lagarto, Cedro Macho. The last-named wood should be studiously avoided, since it rots out in a few months' time. In appearance it resembles Santa Maria, which is an excellent hard-wood similar to our oak. Wily native contractors will try to impose on the uninitiated American, and turn in timber which is of inferior grade but easier to procure in the neighboring forests.

All timbers are whip-sawed by hand in the surrounding jungle, and are then hauled over muddy trails by yokes of oxen to the point of delivery. Lumber ordinarily sells at the rate of $75 per M. ft. B.M. while mine timbers bring about $45 to $55.

Come-Negro or "Iron-wood" is the best mine timber procurable. It weighs about 80 lb. per cubic foot and is as hard as flint. It is almost impossible to drive a nail into the heart-wood, but it can be worked down to shape with good steel adzes. Come-Negro turns black on aging, and seems to be very resistant to wet or dry rot, fungi, and the united attacks of several varieties of white ants.

Granadilla is a beautiful rose-wood, which would be of great value as a cabinet wood, but due to its scarcity and isolation it is chiefly used as a mine timber. It is nearly as heavy as Come-Negro and about as durable under all conditions.

Binbayan is chrome yellow in color, very hard, and suitable for mine timbers, but it checks badly when used in the open air. Santa Maria is the best all-round timber in the bush. Its weight is slightly less than that of water, and its strength greater than that of oak. It is easily worked and has a life of about ten to twelve years under ordinary conditions.

Germany Returns to Adobe Building

THE efforts made toward lowering the cost of building and saving coal in the manufacture of building material have resulted in a reversion to former building methods. Though many of the cheap building methods devised seem to be short-lived, it appears that the adobe building has come back to stay. It has been thoroughly tested under all climatic conditions, and in various forms. The conclusion arrived at, expressed in a recent report made by the Prussian Agricultural Ministry, accepts loam as a suitable building material where greatest economy is the chief object. According to this report the experiences gained with numerous buildings erected in various parts of Germany are very encouraging.

Three forms of adobe construction have been used: The stripped wall in connection with frame work; the rammed loam; and air-dried loam bricks. Good results have been obtained from all three methods.

The first-named method is used for country houses of a more permanent character. Saving-banks have been given permission to grant loans on such buildings. A house containing four rooms, kitchen, garrets, and coops for small animals, costs 52,000 marks without the wood (current value of mark 1.5 cents).

Hammering is performed either by hand or by compressed air, which latter method is declared preferable. With the help of one pneumatic tool and four workmen, a house has been completely rammed in 6 to 8 days. The corners are not made from concrete, as has been suggested, but also from loam, as the two materials have different shrinkage.

Air-bricks are made in usual brick size, larger sizes do not dry well. Loam is also used as mortar. Walls made by such bricks are durable, and they keep out the moisture. Less damage is caused by frost than in the case of rammed loam. As in the case of concrete it is necessary to protect the building against rain while under construction. Before plastering the outer surface is first covered with a coat of tar.

Ramming in of slag or pieces of brick is advantageous, as they draw moisture from the interior of the walls, and also provide a better surface for coating. As lime mortar adheres badly to loam, a coating of loam mortar with an addition of lime in the proportion of 1:2 is first applied, upon which, after drying, the lime coating is put on.

William Hood Retires After Fifty-four Years of Service

Chief Engineer of Southern Pacific Company Closes Long Career of Railroad Building—Many Notable Works

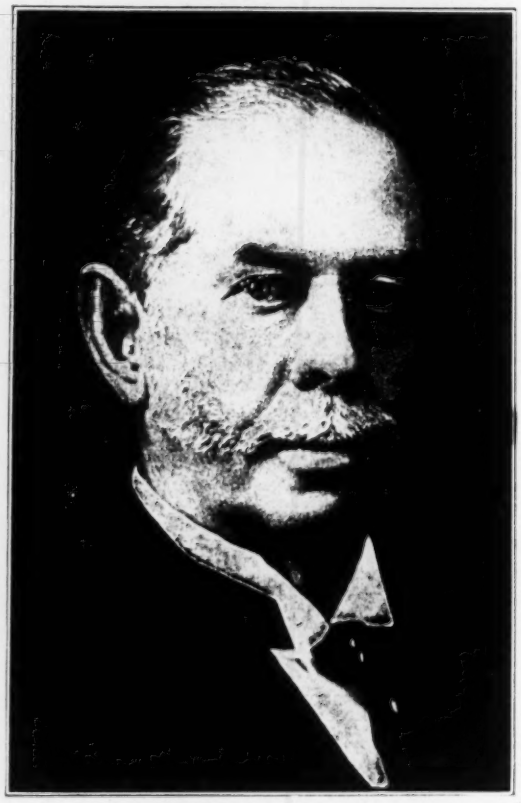
AFTER fifty-four years, to a day, of continuous service in the Southern Pacific Co., William Hood, chief engineer, retired, May 2, announcement being made by President Sproule April 27.

On May 3, 1867, Mr. Hood entered the engineering department of the Central Pacific R.R., now a part of the Southern Pacific Co., as a member of one of the engineering parties constructing the first Pacific-Transcontinental line, which started at Sacramento and met the line from Omaha at Promontory Point on the Great Salt Lake in May, 1869, after the memorable race between the Union Pacific to control the Salt Lake Basin. His first work was as axeman and he was quickly promoted to rodman, and then instrument man and assistant engineer. His career has been one of railroad building, and he has held positions of great responsibility in the engineering department of the Southern Pacific almost since the first construction was started. In 1875, he became chief assistant engineer of the Southern Pacific and the Central Pacific. From 1885 he has been chief engineer of the Southern Pacific Co., Pacific System ,and chief engineer of each of the lines leased by that company. Mr. Hood was born Feb. 4, 1846, in Concord, N. H. At the age of 16 he enlisted in the Union Army and saw active service in the Potomac campaign. After the war he entered Dartmouth College, but in the spring of 1867 he left for California, following newspaper accounts of the attempt being made to build a railroad across the continent. With a letter to Charles Crocket, the construction executive of the Central Pacific, he entered the service of the road on May 3 as an axeman and was sent to Cisco, which was then "end of track" in the Sierras. Within a few months, during the construction of the line and preparatory work on the down grade, Mr. Hood was made assistant engineer under S. S. Montague, chief engineer, who had succeeded Theodore D. Judah. He remained as assistant engineer under Montague during the entire construction, carried out under tremendous pressure, until the two lines met at Promontory Point.

After Mr. Hood was made chief assistant engineer in 1875, he completed the Tehachapi traverse loop on the Valley Route from Oakland to Los Angeles, directing location and construction work in the field.

Possibly the most important and spectacular accomplishment to Mr. Hood's credit was the Lucin cut-off across the Great Salt Lake. Before the railroad passed into the hands of the late E. H. Harriman Mr. Hood had assured Collis P. Huntington that the lake could be spanned at a cost that would not be prohibitive as an economic project to reduce operating costs. Harriman ordered the work to go ahead and in November, 1903, the cut-off was completed, with rock fill hauled from quarries started in mountains to the east and with trestle built at the rate of 1,000 ft. a day.

Retiring Chief Engineer of Southern Pacific Co. Has Served Fifty-Four Years



WILLIAM HOOD

Although Mr. Hood reached the age of 70, five years ago, he has been in active service continuously, spending a large part of his time on the lines, more particularly in connection with the recent construction of the San Diego & Arizona line, which forms a direct connection between San Diego and the inland. This line was started before the war but was not completed until about two years ago. It was shut down for the repair of a tunnel for some time but put in service again last fall. He is widely known among railroad contractors in the West and often he has been called upon to act as the final arbiter in difficult disputes. A familiar biography of him appeared in the *American Magazine*, January, 1921.

With the retirement of Mr. Hood from active service, George W. Boschke, assistant chief engineer, has been appointed chief engineer of the Southern Pacific Co., as noted in the News Section of this issue.

Start Construction of New Trans-Andine Line

Construction on a new international railway to complete direct rail connection between Buenos Aires and either Antofogasta or Mejillones, Chile, was started during the latter part of March. The new link will connect the Argentine city of Salta, near the summit of the Andes, with the west seacoast. The Argentine section is being built from Salta to Huatiquina on the Chilean frontier in the Andes. In Argentina, construction is being carried out by the state railways. The most direct route at present from the Atlantic coast to Buenos Aires is by ship through the Panama Canal to Valparaiso, Chile, and thence by rail over the Trans-Andine Ry. to Buenos Aires, since Valparaiso lies in approximately the same longitude as New York. Antofogasta being several hundred miles north of Valparaiso, on the west coast, is on a more direct route and the journey through the port over the new railroad connection will be shortened by about two days.

LETTERS TO THE EDITOR

If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.

Prof. Hatt Only Ex-officio State Engineer

Sir — The notice of my appointment as State Engineer of Indiana in *Engineering News-Record*, Apr. 14, p. 657, needs some qualification in the interest of accuracy.

Purdue University is co-operating with the State Conservation Commission, and the Professor of Civil Engineering of Purdue was appointed Chief of the Division of Engineering of the Conservation Commission as an addition to his regular duties. Consequently he was not selected from a number of applicants.

There is no salary attached to the position.

W. K. HATT,
Professor of Civil Engineering,
Purdue University.

Lafayette, Ind.,
Apr. 26.

Concrete Building Failure Shows Monolithic Nature of Frame

Sir—With regard to the interesting article which appears in the April 7 issue of *Engineering News-Record*, by Walter H. Wheeler, the problems involved in the reconstruction operations described constitute probably one of the most important phases of reinforced-concrete design and construction.

In many buildings which are in most ways completely adapted to the use of reinforced concrete, there are sometimes conditions which necessitate the introduction of a certain amount of structural steel as the only feasible method of overcoming certain difficulties. In connection with this comes the all important problem of transferring the stresses and strains between two materials—structural steel and reinforced concrete—which by nature of their respective designs are clearly not intended for mixed construction. A combination of the two is generally more of a makeshift than a legitimate design.

The different proportionate deflections between structural steel and reinforced concrete create a feature which must necessarily tend to produce many indeterminate stresses. The exact nature of the regular stresses and strains of reinforced concrete are sufficiently indeterminate in themselves without the additional complications of mixed construction.

In the operations described in the erection of the United States National Bank Building, at Denver, there can be little doubt that it was absolutely necessary to resort to unusual methods. Undoubtedly, structural steel was successfully carried on reinforced concrete in this case, as has been done in other instances. However, I should like to point out that it might not be advisable to make undue reference to the operations as an unlimited precedent for carrying structural steel directly on reinforced-concrete columns and vice versa.

I have in mind an example which leads me to believe that there is an element which strongly prohibits the use of the Denver building as a general precedent. Any reinforced-concrete building, after the concrete has been thoroughly cured, possesses monolithitc qualities which make it possible to remove, sometimes, one or even two of the most important columns in a building, without apparently injuring, in any way, the balance of the structure. Therefore, what may in the case of the United States National Bank building look like a successful operation in mixed construction, may in reality be due more particularly to the monolithic nature of the reinforced concrete than to the ability of reinforced-concrete columns successfully to carry the structural steel directly imposed upon them.

I base my conclusions upon the failure of a 7-story reinforced-concrete building with which I am familiar. The dimensions were approximately 50 x 120 ft. and with skeleton frame throughout, with one row of interior columns and with floors spanned laterally by a concrete joist design. The framework was poured during July and August. The failure occurred the following January, approximately six months after the completion of the concrete frame. Two interior columns between the ground and first floor failed about thirty seconds apart. The cause of the failure was traced to a batch of dirty gravel, and also to the fact that these two columns had been made somewhat smaller in size than the plans called for, through a mistake in construction. The building was re-shored and these columns were replaced by structural steel.

The tensile stress of the reinforcing steel in the original building was figured at 16,000 lb. per square inch, while the maximum compressive outer fiber stress in the concrete beams and floor system was 750 lb. per square inch. The columns were designed for 550 lb. per square inch compressive stress in the concrete. Stone concrete was used throughout, the weight of which was taken at 150 lb. per cubic foot. A net live-load of 50 lb. per square foot was allowed on the floor system throughout, with the usual percentage live-load reductions on columns.

As stated, the columns which failed were smaller in size than the design called for. On this account, these particular columns would have a corresponding compressive stress in the concrete of about 750 lb. per square inch, if the complete dead and live loads for which the structure was designed were imposed. As the building had not been occupied none of the live-load, or any extra load was on the columns at the time of the failure. They failed without warning merely under the dead load of the structure.

It might easily be argued by anyone not familiar with the conditions surrounding the accident that the upper reinforced-concrete columns in this building after the repairs were being successfully carried on structural steel columns. During the time it took to re-shore the building, however, and subsequently to place the steel columns in position, no cracks developed, even in the beams and floors, immediately above and adjacent to the defective columns which failed.

R. E. W. HAGARTY,
Consulting Engineer.

Toronto, Ont., April 20.

Predicting Probable Rainfall Intensities

Sir—I have been much interested in the article, "The Prediction of Probable Rainfall Intensities" by Kenneth Allen, appearing in Enginering News-Record, April 7, 1921, p. 588, as indicative of the increasing use which is being made of probability methods in studying problems connected with hydrology. In a discussion of a paper by me entitled "The Probable Variations in Yearly Runoff as Determined from a Study of California Streams," which appeared recently in the *Proceedings* of the American Society of Civil Engineers, Mr. Allen referred to his probability paper for predicting rainfall intensities, but at that time presented none of his basic data and did not outline the method of derivation of his paper.

In reviewing Mr. Allen's article it has been noted that although the record from which the data were obtained covered a period of 51 years, in tabulating the maximum rainfall intensities in Table I, the total number of occurrences of total frequency is always less than 51; in other words there are always certain years in the record which remain unaccounted for. As the rainfalls of longer durations are approached this omission becomes more apparent. For example, for durations of 120 minutes there are only 16 occurrences tabulated and these are used to represent 100 per cent of the time. As a matter of fact, they cover only (16 + 51) 31.4 per cent of the time. If, in tabulating the results, the maximum total rainfall in different periods of time (expressed perhaps in intensities per hour) had been used this difficulty would have been overcome. Thus, if a certain storm showed a total rainfall of 2 in. in 80 minutes, the same total would hold for 100 and 120 minutes; the fact that the rain may have ceased after 80 minutes would be immaterial. The principal point is that in deter-

mining total frequencies every year in the record must be considered.

In determining the average curve shown in Fig. 1, Mr. Allen has assumed that in corresponding intervals from the mean, proportional to the standard deviation, the frequency in all series will be a constant. The writer has seen this assumption applied in other cases and while it may hold with records having approximately the same coefficients of variation, as a general theorem it has no justification. The coefficient of variation, *CV*, is obtained by dividing the standard deviation by the mean. As it is a pure number and not affected by the magnitude of the quantities involved, it is more useful than the standard deviation in comparing the relative dispersion of the series involving quantities of varying magnitude. As an example of the fallacious results that the assumption referred to above may lead, consider two series having *CV*'s of 0.20 and 0.60, respectively. In the first case a negative deviation of 2 to 2.25 of the *CV* would lie between 55 and 60 per cent of the mean, such a variation is entirely possible; in the second case the same negative deviation would lie between —35 and —20 per cent of the mean, and as zero is the lower limit for such phenomena as rainfall intensities such a deviation is absolutely impossible. A comprehensive study of a large mass of runoff data has convinced the writer that for this class of phenomena the type of the frequency curve changes with the increase in the coefficient of varition. (See p. 9 closure to my paper in Proceedings, Am. Soc. C. E., Feb., 1921.)

In general, the method employed by Mr. Allen is the logical one to use in treating statistics of this nature and the results obtained are probably quite satisfactory, but with a more careful attention to the points made above the final curves would yield a closer agreement with the actual probabilities of the case. As mentioned in the article, the use of theoretical statistical methods is quite laborious and rather complex, hence when adopting such treatment it behooves the engineer to carefully analyze his data and the application of the theory of probability thereto, before commencing the actual work of determining the frequency distribution.

L. STANDISH HALL,
Hydraulic Engineer.

San Francisco, Cal., April 20, 1921.

Sir—Referring to the foregoing comments of L. Standish Hall on my method of predicting rainfall intensities, I would say in the first place that Table I is based on a record published by the Municipal Engineers of the City of New York in their Proceedings for 1913, extended to embrace the year 1920.

In preparing the table, the omission of certain downpours in the earlier tabulations was taken to indicate a failure to record the rates left blank for these years, and this seems to be true in a few instances. But in the majority of ommissions, which are confined to periods of 80, 100 and 120 minutes, it would appear, on further investigation, that Mr. Hall is correct in his contention that the percentages in Table I should be based upon the complete 51-yr. record. He probably overlooked the fact that storms of over 60 minutes' duration were not used in the computation of Standard Deviation (Table III), and as the greatest number of omissions in the 51-yr. period for any year is 5 (for 40, 50 and 60 min.) and 0 to 2 for the five shorter durations, the resulting curves up to 60 min. are practically correct.

The original tabulation might have included a figure for every duration up to 120 minutes, as rainfalls of greater duration occur every year. But in their absence I am unable to find any warrant for supplying the omission by assuming rates for their durations equal to half the downpour of some shorter period, such as 80 min., as proposed by Mr. Hall.

Mr. Halls' second criticism is of the assumption that "in corresponding intervals from the mean, proportional to the standard deviation, the frequency in all series will be a constant," but he adds that "it may hold with records having approximately the same coefficient of variation." The following table gives the coefficient of variation calculated by dividing the Standard Deviation by the mean for the series of data in question.

Downpour Interval	*CV*	Downpour Interval	*CV*
5 min.	0.298	30 min.	0.42
10 min.	0.329	40 min.	0.39
15 min.	0.368	50 min.	0.40
20 min.	0.399	60 min.	0.40

The *CV*'s quoted in Mr. Hall's original paper have a decidedly wider range than this, running from 0.21 in the case of Stream 28, to 0.81 in the case of Stream 32.

Mr. Hall is no doubt correct in saying that the assumption that the frequency for all series is a constant has no justification "as a general theorem."

If I am not mistaken, he would suggest, in place of my Fig. 2, a series of diagrams, each for a single duration and with a special ruling. The graph on each would then be a straight line and the result would undoubtedly be more accurate, but the work involved could hardly be justified as a practical procedure. The method described in my article, by which an average curve of Standard Deviation is employed, appears to overcome the difficulty without a material sacrifice of accuracy.

The absurdity mentioned by Mr. Hall of any method resulting in negative rainfalls is evident and might perhaps exist in attempting to combine the New York rainfall record and that of say Phoenix, Ariz., in the calculations for Fig. 1, but the fact is that in the New York computations such a situation did not exist. The lower limit of the frequency curve in Fig. 1, or the point at which the rainfall will be exceeded every year, is 2 SD below the mean, and the following table gives the values of this point translated back into inches of rainfall per hour for the eight series of data utilized in computing the probability ruling.

5 min.	1.90 in. per hr.	30 min.	0.33 in. per hr.
10 min.	1.26 in. per hr.	40 min.	0.68 in. per hr.
15 min.	0.82 in. per hr.	50 min.	0.30 in. per hr.
20 min.	0.53 in. per hr.	60 min.	0.27 in. per hr.

Conceding that by some imaginary combination of rainfall data, an absurd result might be reached the above tabulation shows that as a matter of fact this was not the case.

It should be stated that the computations and diagrams shown in the article referred to were all prepared before receiving the reprint of Mr. Hall's paper on "The Probable Variation in Yearly Runoff" and any advantage in using the Coefficients of Variation instead of Standard Deviations did not seem to warrant the recomputation and plotting of the data. It was my intention to prepare a paper so ruled that intensity of frequencies could be plotted as described, with graphs approximating straight lines, and the use of Standard Deviations seemed a good basis for this purpose. It is quite probable that there may be some better method of securing this result, possibly by the use of Coefficients of Variation as proposed by Mr. Hall. Mr. Hazen's paper, to which I referred, suggested a number of probability rulings, one of which might be selected which would avoid the laborious computation involved in either Mr. Hall's method or mine.

KENNETH ALLEN.

New York City, May 9.

Road Work, Mosquitoes and Malaria

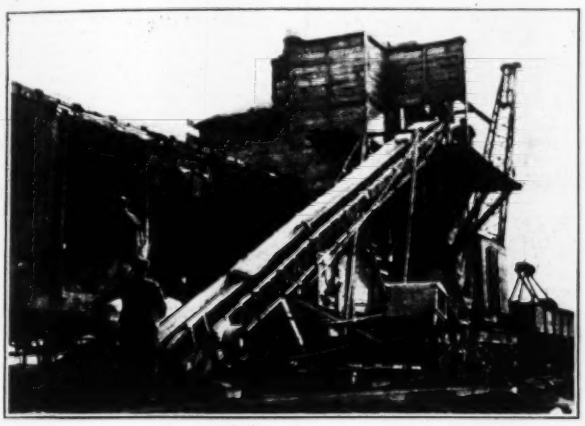
That road construction and maintenance should be so carried out as to avoid leaving pits or improperly drained culverts in which water may accumulate and give rise to mosquito breeding, and thus probably contribute to the spread of malaria, is urged in a circular recently issued by the U. S. Public Health Service. The importance of this precaution has been recognized by Dr. T. F. Abercrombie, health officer of Georgia, who, according to the circular, "has suggested that the convict and other gangs who work along the roads be required to fill up borrow-pits, place culverts properly, clean ditches, and attend to other small but important details that any man can do and that will deprive the mosquito of many of her breeding places."

HINTS FOR THE CONTRACTOR

Portable Belt-Conveyors Handle Cement to Elevated Mixers

PORTABLE belt-conveyors fitted excellently into two concrete plants employed in 1920 on Government work near Savanna, Ill. A concrete pit 1,600 ft. long, 234 ft. wide, and 10 ft. deep was constructed to store about 6,000,000 bu. of nitrate. The floor and side walls were 5 in. thick of reinforced concrete.

Two concrete plants, on opposite sides of the pit, were mounted on gondola cars. Each plant consisted of a mixer, with bins mounted above it for the storage of sand and stone. The sand and stone were unloaded



CAR MOUNTED MIXER PLANT WITH PORTABLE CEMENT CONVEYORS

from cars with a locomotive crane and placed in the bins as needed. The cement car was spotted at one end of the plant car and the sacks as unloaded were placed on a Barber-Greene portable belt conveyor which carried them up to the platform where men measured the materials and charged the mixers.

The mixed concrete was spouted into place where possible and beyond the reach of the spout was carted and dumped into place. The entire operation was carried on with practically no lost time, when moving, the locomotive crane picked up the spout, trestle, etc., and carried all to the next set-up.

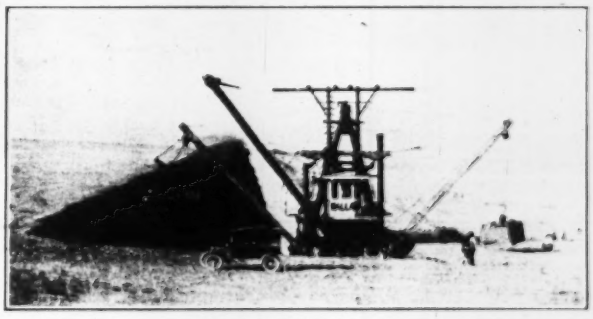
As first planned, the locomotive crane handled the cement from the car to the platform, lifting it on a large wooden skip. However, this consumed time when the crane should have been handling sand and gravel so the conveyors were added. The second day of operation the output was increased 20 per cent. The conveyors operated at an angle of 26 deg. and handled a maximum of ten sacks per minute though on the average they carried five sacks per minute. They were 38 ft. long and were driven by 15-hp. gasoline engines.

Henry W. Horst Co., Rock Island, Ill., were the contractors and, when this contract had been completed and work started on a concrete road contract, they planned a central mixing plant requiring two conveyors to handle sand and gravel to storage bins.

Dredge Digs Narrow Canal

IN PLANNING the construction of a canal 18 ft. wide in the Sacramento Valley, the use of a floating clam-shell dredge was decided upon as the cheapest method of carrying out the work. In order to place the excavated material back far enough from the edge of the canal to leave the prescribed width of bern, a boom exceeding 60 ft. in length was necessary. Such a boom would ordinarily require a dredge with a hull wider than could be floated in an 18-ft. canal, or the use of so-called "bank spuds." The latter were not considered feasible because the material traversed was very soft. A plan was developed, however, whereby with the use of counterbalances, 12 miles of 18-ft. canal were built with a dredge floating in the canal and without disturbing the canal banks.

The dredge used for this purpose had a hull 16 ft. wide, 65 ft. long and 5½ ft. deep. The boom was 75 ft. long and operated a 1¼-cu.yd. bucket. To adapt the dredge to this special work, timbers were stepped on either side of the A-frame and from their ends were suspended boxes filled with earth to serve as counterweights. The distance of the counterweights from the side of the hull was made great enough so there was no danger of sloughing the soft material along the bank.



DREDGE WITH COUNTERWEIGHTS IN ACTION
(Note that counterweight to the right is suspended while the other rests on the spoil bank)

The length of the lines by which the weights were suspended was also adjustable and the height of the weights was changed as often as was necessary to keep them hanging only a few feet above the ground. Thus when the loaded boom swung to the starboard side, the list of the dredge hull caused the starboard counterweight to rest on the ground, leaving the port counterweight to balance the overturning moment of the loaded bucket. When the boom returned toward the center and the hull righted itself, the counterbalance that had rested on the ground was again lifted. The dredge was always free to move forward when the boom was on center line. Ordinarily one of the counterbalances was hung just over the spoil bank and rested upon it when the boom was swung into dumping position.

The work was done by the Ajax Dredging Co. under the general direction of F. F. Cooper, general manager and chief engineer.

NEWS OF THE WEEK

New York, May 12, 1921

Vehicle Tunnel's Engineer Board Told to Quit

Jersey Commission Acts Independently of New York Body Which Denies Its Jurisdiction

Controversy over the proposed widening of certain streets in Jersey City, involving a difference of opinion as to whether or not the work should be paid for as part of the Hudson River vehicular tunnel project upon which the states of New York and New Jersey are engaged under a joint agreement, culminated in a resolution passed by the New Jersey Interstate Bridge and Tunnel Commission at its meeting April 26, discharging the board of consulting engineers consisting of Col. W. J. Wilgus, Major John A. Bensel, Prof. William H. Burr, Edward A. Byrne, J. Vipond Davies, and Col. George L. Watson. The New Jersey commission's action was taken without giving the members of the consulting board an opportunity for a hearing and on the ground that the consulting engineers and the engineering staff had failed "to give full and proper consideration to the plan as a whole and to the traffic conditions in the vicinity of the Jersey City entrance and exit," thereby delaying the work.

The New York State Bridge and Tunnel Commission, May 10, denied that the New Jersey body had jurisdiction in the action it had attempted to take and refused to follow its example in appointing three new members to the consulting board. A statement signed by the members of the "dismissed" board was also issued denying that the action taken had force.

It is understood that three of the eight Jersey commissioners opposed the passage of the resolution and demanded evidence justifying the dismissal of the consulting board, but they were met only with cries of "Vote," and the measure was railroaded through. In place of the present consulting board, the New Jersey commission appointed as its representatives on the board George M. Wells, St. John Clarke and Col. George L. Watson, and suggested that New York also appoint three representatives. The chief engineer to the two commissions, Clifford M. Holland, is not mentioned in the New Jersey resolution ousting the consulting board.

The New Jersey commission's action was made independently of the New York commission and doubt has been expressed as to its regularity, especially in view of a clause in the resolution originally appointing the board of consulting engineers which states: "That said board of consulting engineers shall be filled by appointment by the two commissions, to hold office at the pleasure of the said commissions." It will be noted that in each case the plural of the word "commission" is used. As the members of the New York body have not concurred in the resolution of the New Jersey commission, the opinion has been expressed that the action of the New Jersey body is without legal status.

The main points in the history of the controversy may be briefly stated as follows: After a contract for sinking the tunnel ventilating shafts on the New Jersey side has been publicly advertised in March the call for bids was suddenly rescinded when the New York commission refused to accede to demands of the New Jersey representatives for the widening of a number of streets beyond the tunnel entrance in Jersey City. The chief engineer's plans as published in his 1920 report provided for an entrance plaza at 12th St., but the majority of the New Jersey commission caused a deadlock by demanding the widening, in addition, of 14th St., Henderson St., and Jersey Ave. This additional street widening, the New York commissioners maintained, was purely a local improvement for Jersey City and, as such payment for it by the States of New York and New Jersey could not be justified. The point as to whether New York has the right, under the provisions of the interstate tunnel treaty, to participate in the expense of the street widening work in Jersey City is now before the attorney general of New York for a ruling.

The proposed street widening has been made a political issue in the Jersey City election this month.

Western Society Elects Officers on Regular Ticket

In the electrion of officers for the Western Society of Engineers, the entire regular ticket was carried by a large majority. President, Charles H. MacDowell, president of the Armour Fertilizer Works; vice-presidents, Julius L. Hecht, F. F. Fowle and Benjamin S. Shapiro; trustee, Edwin W. Allen; treasurer, Homer E. Niess; members of Washington Award Commission, John F. Hayford and Henry J. Burt.

Some of the sections of the society have elected chairmen as follows: Railway section, F. L. Thompson, chief engineer, Illinois Central R. R.; bridge and structural section, J. E. Love, structural engineer, H. T. Ryerson & Son; hydraulic, sanitary and municipal section, L. R. Howson, of Alvord & Burdick, consulting engineers.

Federal-Aid Road Bill Impresses Legislators

Dowell Measure Carefully Drafted — Vulnerable Points Discussed in Townsend Bill

(Washington Correspondence)

There is a very general feeling on Capitol Hill that the state highway officials did themselves proud in drafting the federal-aid road bill which was introduced by Representative Dowell, of Iowa, May 3. That it has been worked out with the greatest care is admitted, even by opponents. Lawmakers who are not greatly concerned as to which of the highway policies is adopted regard the Townsend bill as being much more vulnerable than is the Dowell measure.

So far as its legislative course is concerned, the most vulnerable point in the Townsend bill, it is believed, is the fact that five men are to sit in Washington and lay out all the roads in the United States. There is very strong feeling in Congress against forcing people to come to Washington, "hand in hand," to make arrangements to comply with a federal law and the administrative regulations which go with it. Regardless of the advantages which may be gained in the selection of a road system by a central commission stationed in Washington, such a plan is assured in advance of strong opposition. This sentiment is a legacy from the war period when licensing and permit systems made it necessary for a very large number of persons to journey to the capital to discuss complicated points arising in the issue or administration of such permits. This procedure came into such disfavor that its continuance has been avoided, wherever possible, in subsequent legislation. The fact that the people of the several states would have to come to Washington to get their roads on the map is expected to arouse a type of opposition which it would be hard to appease. The selection of highways by a commission in Washington, friends of the Dowell bill contend, is approaching the problem from the wrong end. They contend that the people in the locality must select the roads. It is pointed out, in that connection, that even when selected locally, the designation of roads for improvements almost always gives rise to heated controversies, while bitter fights are not infrequent.

Another element of weakness in the legislative position of the Townsend bill is the fact that it is open to the contention that the federal highway commission plan would add to the overhead expense of road construction.

There would be five commissioners at a salary of $10,000 each. It is admitted that the establishment of a commission would in no way curtail the present force employed by the U. S. Bureau of Roads. A chance will be given opponents of the bill to argue that the tendency would be to build up a much larger bureau.

The fact that no definite system of roads is outlined in the Townsend bill is certain to give rise to apprehension in the states as to the mileage which may be expected. Sight will not be lost of the fact that the first Townsend bill planned to expend all federal funds on two roads, and no more, in each state.

The provision in the Townsend bill empowering the commission to maintain a federal-aid highway, if the state fails to do so, is certain to meet with the criticism that this would put the government into the construction business on a large scale. The corresponding provision in the Dowell bill is very generally considered the stronger. In the Dowell bill, the Secretary of Agriculture is empowered to let a contract to cover a default in maintenance and charge the cost of the work against the federal funds allotted to the state. The Secretary is precluded from approving further projects for that state until the state has reimbursed the federal government. The funds thus repaid are returned to the treasury and are forever lost to the state.

Hearings on the Townsend bill are to begin in the near future; at this writing, the exact date has not been set. Members of the House committee on roads have not determined whether or not it will be necessary to hold general hearings on the Dowell bill.

Two Confirmations Complete Membership of I. C. C.

With the confirmation by the Senate of E. I. Lewis of Indianapolis and J. D. Campbell of Spokane as members of the Interstate Commerce Commission, all of the vacancies on the commission have been filled. The incoming administration found four vacancies on the commission. Mark W. Potter, who was nominated by President Wilson but whose nomination was not confirmed at the last session of Congress, was re-nominated by President Harding and was confirmed early in the present session. The other vacancy was filled by the appointment of John J. Esch.

New Bascule Span for Troy, N. Y.

A 224-ft. double-leaf bascule is to be built as part of the 12th St. bridge over the Hudson River and Barge Canal, at Troy, N. Y. The state engineer's office adopted the Strauss type of bascule for this structure, and designs are now being prepared by the Strauss Bascule Bridge Co., Chicago. The bridge will carry both street car and highway traffic.

Ridgway Named Chief Engineer of N. Y. Transit Commission

Robert Ridgway has been made chief engineer and Daniel L. Turner consulting engineer of the newly created Transit Commission in New York City, which takes the place of the Transit Construction Commission. In the new division of duties Mr. Turner, who has served since 1916 as the commission's chief engineer, will devote his entire time to the planning of transit facilities for New York while Mr. Ridgway, formerly engineer of subway construction, will, in his new capacity of chief engineer, have administrative charge of all design and construction work. Both engineers will receive a yearly salary of $15,000 and will report to the newly appointed executive officer of the commission, Brig.-Gen. Lincoln C. Andrews, U.S.A., retired.

Other appointments announced in connection with a valuation of existing transit lines, proposed by the new commission, are as follows: John H. Madden, valuation engineer, at a salary of $1,000 per month while employed; F. W. Lindars, chief accountant, at $10,000 a year; Major John C. Hooper, assistant chief accountant, at $6,000 a year; Capt. Edward T. Fitzgerald, acting chief of the transit bureau, at $4,000 a year. All of the new appointees, according to chairman George McAneny, were connected with the old Public Service Commission before the war.

Chicago Stops Bridge Work

Owing to the city's shortage of funds an order from the municipal authorities has stopped all contract work on the new Chicago River bridges.

New Acting Secretary of American Society of Civil Engineers

ELBERT M. CHANDLER

Los Angeles Terminal Plan Is Ordered

State Commission Adopts Plaza Union Station Project—Under Joint Engineering Committee

The Railroad Commission of California on April 26 ordered the four railroads entering Los Angeles to proceed with the Plaza union terminal. The order directs that (1) a joint engineering committee, to supervise and direct the construction of the union depot, be selected within 30 days after May 20, 1921, when the order becomes effective; (2) that plans covering the necessary grade changes be filed within 60 days, and (3) that plans for the union depot be filed within 6 months. The work can be completed within five years, the commission states. The first step is to eliminate grade crossings, particularly along Alameda St., and pending these changes the city is directed to withhold future permits for industrial tracks in the streets. The railroads involved are the Southern Pacific, Santa Fe, Los Angeles & Salt Lake and the Pacific Electric. The provisions of this order, however, do not require the Pacific Electric to make grade separations since the commission is now conducting a separate investigation into the affairs of this road.

The joint committee is to consist of two men appointed by the city and two by each of the roads, they in turn to select a disinterested party to serve as chairman. If a chairman cannot be agreed upon, he will be appointed by the commission. The order states that "the commission assumes that the city will carry out its repeatedly affirmed intention to further in every possible way the consummation of the general plan."

The cost and division of the expenditure is not covered in this order and is not to be taken up in detail until after the plans of the joint engineering committee have been filed. The order is accompanied by a table showing the itemized cost estimate of all the work involved, as made by the commission engineers, totaling $25,000,000, and also that made by the railroad engineers which totals $45,000,000. The order specifically states, however, that these tables are used to identify construction items and not as a finding of cost.

The commission's order contains a résumé of the union terminal project history. In 1915 Los Angeles organizations petitioned the commission to order the elimination of grade crossings. A friendly suit that was then instituted in the State Supreme Court resulted in a decision that the commission had full authority in the premises and should satisfy the petitioners. Meantime the city advanced $20,000 toward the cost of an engineering report concerning complete grade crossing elimination to be made by the commission.

After a two-year study the engineering department of the commission brought out a 1,000-page printed report that considered three locations and

carried a recommendation for adopting the Plaza site. This was two years ago. The Mayor of Los Angeles then appointed a board of five engineers to review the report and submit conclusions. This board approved the Plaza site and, in general, the commission's findings as a whole. Following this, both the commission and the city held public hearings on the question of location. For several months since these hearings the commission has had the matter under advisement and has finally handed down the order announced in the foregoing.

In its report the commission says: "Representatives of the Southern Pacific, the Los Angeles & Salt Lake and the Pacific Electric railroads have frankly admitted that they are in opposition to any plan that will interfere with the consummation of their own proposal, which provides for a partial union passenger terminal on the present Southern Pacific depot site. These railroads are not opposed to terminal unification *per se*, rather are they in favor of it. They do not desire however, to depart from their own plans."

Press reports state that the several railroads affected will fight the decision in the United States Supreme Court, on the ground that the commission has acted without authority.

Missouri Franchise Tax Law Is Held Constitutional

That the Missouri franchise tax law is not in contravention of the commerce clause of the Constitution is stated in the opinion rendered by the Supreme Court of the United States on May 2. This decision sustained the opinion of the lower court, which had ruled adversely on the application of the St. Louis-San Francisco Ry. Co. to restrain the State of Missouri from collecting the franchise tax. That the value of the franchise is derived partly from the fact that the corporation operates in interstate commerce does not invalidate the tax, the court holds. The Supreme Court also expresses the opinion that the constitution of Missouri has not been violated. "We cannot much doubt," says the opinion, "that the tax was intended to be measured by the proportion of stock and surplus in the state and that the omission of reference to surplus is a misprision or abbreviation that does not conceal the purpose to be gathered from it."

Interstate Drainage Lawsuit Is Reopened by Court

The final decision of the U. S. Supreme Court in the Dakota-Minnesota drainage case will not come as soon as expected. Although the final hearing has been held (see *Engineering News-Record*, Jan. 27, p. 187) the court has decided to hear further testimony from each side as to the possibility, within the limits of reasonable expenditure, of improving the flood conditions along the Bois de Sioux River by means other than an injunction against the maintenance of drainage ditches. The various means suggested for relief are: (1) Detaining basins in the Mustinka watershed, (B) a sluice dam to make Lake Traverse a detaining resorvoir, (C) dredging the channel of the Bois de Sioux River, (D) discharging part of the Lake Traverse waters south into Big Stone Lake, (E) diverting part of the upper Mustinka River flow into the Rabbit River.

Evidence concerning the proper equitable basis for apportioning the expense of any feasible project among the states drained is also asked by the court, which included other minor matters in the order. Thus the final decision will be delayed for several months at the least. Proposed improvements at Lake Traverse and on the Bois de Sioux River, as recommended by the U. S. Department of Agriculture, were described in *Engineering News-Record* July 29, 1920, p. 225.

Dismiss Luten Suit Based on Falsework Patents

Two of the Luten falsework patents, Nos. 802,004 and 1,106,880, the first entitled "Centering For and Method Of Constructing Arches," and the second, "Falsework," figure in the suit decided March 24, 1921, by Judge A. S. Van Valkenburgh in the District Court of the United States for the Western Division of the Western District of Missouri. Suit was by Daniel B. Luten against the Kansas City Bridge Co. for the infringement of the patents of falsework for concrete bridges. These patents, as is well known, involved the use of falsework struts too weak in themselves to support the required load, but made strong enough by braces or wiring. The special feature in the design is the fact that the arch may be struck by cutting the braces or the wiring, thereby throwing the load onto two or more separate members instead of the composite member; the separate members, being weaker, deflect sufficiently to strike the arch.

Judge Van Valkenburgh stated that it is but an obvious departure to substitute for a large timber a smaller one and to supply the difference in sustaining strength by the addition of braces. "Patentable invention," he said, "cannot be made upon well known inherent qualities, attributes and functions of natural substances, such as wood, iron or steel. It is quite obvious that a timber too small in itself to support a given load, and raised to the required strength by the addition of braces, will buckle or bend if the braces are removed. . . . I am unable to perceive in either of the patents evidences of inventive genius as distinguished from mechanical and engineering skill stimulated by ordinary technical study and experience. . . . Being of opinion that the devices in question do not embody patentable novelty and invention, the plaintiff's case must fail. The motion to dismiss is sustained."

Belle Isle Bids Again Rejected and New Bids Asked

Acting upon the recommendation of the commissioner of public works, Joseph A. Martin, the Detroit city council has instructed the department to reject all bids opened on April 23 for the construction of the Belle Isle bridge, including the bid submitted by the department itself, and to advertise for the fourth time, bids to be opened May 21. This action was taken when it was found that the bid of the Arundel Corporation could not be trimmed to come within the bridge fund. Bids are now asked on the same quantities and plans as for the bidding of April 23, conforming with the revised plans as worked out by Esselstyn, Murphy & Hanford, engineers in charge of the design and supervision of the bridge, but the quantities are grouped into four groups and a total cost limit is included.

Group A covers the substructure (wet and dry exeavation, wood piling, concrete pier footings and abutments, cofferdams and the removal of existing piers). Group B includes structural steel and bronze bearings, erected. Group C comprises the concrete in the bridge superstructure, reinforcing steel, roadway work and waterproofing. The metal handrailing constitutes Group D. The total limit of cost is placed at $2,401,672, this being the sum remaining of the $3,000,000 bridge fund voted by the people. A subway approach to the bridge has already been constructed at an approximate cost of $400,000, and this amount has been paid out of the bridge fund.

By asking for separate bids for the four groups, it is hoped that the construction of the bridge can be gotten under way without further delay as there is a possibility of letting a contract for at least part of the structure such as the substructure or foundation, in event a bid is received which comes within the engineers' estimates. The city is hopeful of receiving satisfactory bids because of the decreasing costs of material. The letting of a contract for part of the bridge would be in line with the policy Mayor Couzens advocated when the first bids were opened. The council took an opposite position at that time since the low bids indicated that the bridge could not be completed with the money available.

Canadian Government Takes Over Control of Grand Trunk

The bill introduced in the Canadian House of Commons on April 19 by Premier Meighen to take over control and operation of the Grand Trunk Ry., as a condition to proceed with arbitrating compensation to be paid stockholders and to continue to absorb the operating deficits of the property, was passed by the House, April 26. There was very little opposition to the bill, which outlines further terms upon which the government will proceed in

undertaking and provides that the directors of the Grand Trunk and its subsidiaries are to resign when requested to do so, to be succeeded by a board named by the government. The board may carry on the business of the company without reference to the shareholders. It allows the company until May 16 to accept the terms offered. A committee representing the shareholders will be appointed to present their case in a continuation of hearings before the Board of Arbitrators, the powers of which are now extended.

The arbitration board had withdrawn officially April 9, discontinuing the proceedings, since the original agreement between the government and the Grand Trunk R.R. provided that the arbitration should be completed by that date. It was charged by the government that the railway company had dragged out the arbitration proceedings unnecessarily and it was argued that the only recourse now would be to assume actual control of operation.

Minnesota Valley Drainage and Conservancy District Formed

Ten district court judges, sitting in bank at Mankato, Minn., April 25, ordered the formation of the Minnesota Valley Drainage and Conservancy District. The district is to consist of all valley lands adjacent to the channel of the river from the upper end of Big Stone Lake (the continental divide) to within about 15 miles from the confluence with the Mississippi at St. Paul, embracing about 272,000 acres.

The action of the court resulted from a series of hearings, covering a period of four months, on a report submitted to the state commissioner of drainage and waters by Adolph F. Meyer, consulting engineer, of Minneapolis. A chief engineer and a consulting engineer will be appointed by the district as soon as formed. The Minnesota Legislature has made an appropriation of $35,000 to enable the comissioner of drainage and waters to prepare necessary plans for the structures for this project. The commissioner also has an appropriation of $25,000 with which to prepare plans for the Red Lake River drainage and navigation project. Congress, at the last sesion, also appropriated funds for the latter.

Railroad Hearings Start Before Senate Commerce Committee

The Senate Interstate Commerce Committee, acting under the Cummins resolution passed by the Senate April 19, to investigate the railroad situation of the country, with special reference to the causes of high operating expense, began its hearings May 10. Railway executives will be the first witnesses to be heard. In the meantime the railway labor unions have publicly charged the railroad managements of wasteful practices amounting to more than $1,000,000,000 a year.

Public Roads Report on Arkansas Situation Is Submitted

Supported by transcripts of records, financial accounts, engineers' reports and other data, the findings of E. W. James, assistant engineer, Bureau of Public Roads, on the Arkansas road situation have been made to the chief of the Bureau, Thomas H. MacDonald. (See *Engineering News-Record* April 7, p. 611, and April 21, p. 699.)

The government investigation reveals that whereas its interest have been fully protected, though with some difficulty, a continuation of the present system of taxation for road improvement will become, in many cases, burdensome. The report also charges that the state highway department is not equipped to carry on so large a program as is outlined for the state, and that "the administration of road matters is open to serious criticism," especially in some of the improvement districts.

The report concludes with the recommendation that "no further progressive payments on Federal-aid projects be made in Arkansas until the existing conditions are corrected and that all payments be witheld until the completion of the projects."

Michigan Port Bill Fails to Pass

The resolution introduced into the Michigan Legislature to amend the state constitution, authorizing the incorporation of port districts with power to engage in work of internal improvement, to take advantage of the proposed St. Lawrence waterway, failed to pass in the regular session of the legislature and will be brought up again at the coming special session. If passed then, the question will go to the voters in time for an enabling act to provide for starting port development work in the summer of 1923. Particular interest attaches to the bill in Detroit since it is assumed that its introduction was primarily to affect that port.

To Build Railroad for Construction of Power Development

For the purpose of serving construction work of the Pit River (Cal.) project, plans have been completed by the Pacific Gas & Electric Co. for the construction of a broad gage railroad 32½ mi. in length. The line will start at Bartel, at the end of the present system of the McCloud River Railroad Co., and will run east through Cayton Valley to the sit of Pit River Power House No. 1. The new line will distribute construction materials for all of the power houses on the Pit River project, and will be built to reduce the cost of hauling by truck. Analysis showed that the rail line, with maximum grades of 4 per cent, would be cheaper than to a continuation of the use of trucks. Fifty-pound rail is being used.

Wallace Discusses Engineering Federation's Work

L. W. Wallace, executive secretary of the Federated American Engineering Societies, has returned to his office in Washington after a visit to Milwaukee, Detroit and Chicago. At Milwaukee, he addressed the Society of Industrial Engineers on industrial leadership. At Detroit, he spoke at the annual banquet of the local engineering societies. In Chicago, he attended a meeting of American Engineering Council's committee dealing with the licensing of engineers. This committee, in view of recent legislation, has made certain changes in its model bill. These changes will be laid before the executive board of the council at its June meeting.

San Francisco Water Front Still Under State Control

The bill before the California legislature which proposed the transfer of control of the waterfront at San Francisco from the state harbor commission to the city of San Francisco, has been defeated after a long fight on the floor of the senate.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York; Spring meeting, Chicago, May 23-26.

AMERICAN WATER WORKS ASSOCIATION, New York; Convention, Cleveland, June 6-10.

NATIONAL FIRE PROTECTION ASSOCIATION, 87 Milk St., Boston. Annual meeting, San Francisco, June 14-15-16.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual meeting, Asbury Park, N. J., June 20-24.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh, Pittsburgh, Pa.; Annual Convention, New Haven, Conn., June 28-July 1.

American Society for Testing Materials.—A tentative program for the annual meeting at the New Monterey Hotel, Asbury Park, N. J., June 20-24, has been issued. Monday afternoon and evening, June 20, are to be devoted to committee meetings. Three sessions will be held Tuesday with the presidential address and a dance and smoker at night, two meetings on Wednesday, with committee meetings in the afternoon, three meetings on Thursday and two on Friday, with the golf tournament in the afternoon. Cement, concrete and road materials come on Wednesday, testing and oil products on Thursday and the metals on Friday.

The nominating committee has named for president, C. D. Young, general supervisor of stores of the Pennsylvania R. R.

The American Society of Safety Engineers has made application for charter membership in the Federated American Engineering Societies.

The Engineers' Club of Philadelphia, at its luncheon meeting, May 17, will be addressed by Axel Malm on "Business Methods of European Engineers Compared With Those of American Engineers." On the evening of May 17 the annual meeting will be held, with election of officers. The meeting will be addressed by Guilliaem Aertsen, the retiring president, and after the regular meeting a film, "The Story of Asbestos," will be shown.

PERSONAL NOTES

JAMES V. KARRICK, formerly with the Hughes-Keenan Co., Mansfield, Ohio, as assistant engineer on structural steel work, is now bridge designer with the Kentucky Highway Commission at Frankfort, Ky.

ROSS EVERLEY, for a number of years engineer and inspector of construction on government projects for the Bureau of Yards and Docks of the Navy, is now superintendent of construction with the Magic City Building Co., Miami, Fla.

CLARENCE B. MYERS, formerly with the Pennsylvania State Highway Department, has been appointed assistant engineer Philadelphia Bureau of Highways.

H. G. SHULDE has been appointed district engineer Pennsylvania State Highway Department, with headquarters at Bedford, Pa.

CHARLES SMITHLEY has been appointed county engineer of Geary County, Kan.

J. O. CORWIN, JR., has been appointed engineer of Travis County, Tex.

R. N. KINNAIRD, formerly with the Des Moines Water Co., has opened an office as consulting engineer in Des Moines.

STANLEY M. MCKEE has been appointed consulting engineer for the Republic Iron & Steel Co., Youngstown, Ohio, to succeed C. C. Shackelford, resigned.

J. M. R. FAIRBAIRN, chief engineer of the Canadian Pacific Ry., and R. A. Ross, member of the Administrative Commission of Montreal have been awarded the degree of Doctor of Science by the Senate of the University of Toronto.

C. R. MEE has been appointed chief engineer of the Louisiana Railway & Navigation Co., with headquarters at Shreveport, La.

GEORGE W. BOSCHKE, assistant chief engineer Southern Pacific Co., Pacific System, was appointed chief engineer effective May 3 last, succeeding William Hood, who has retired from active service, as noted on page 824. Mr. Boschke was born in San Francisco in 1874. He began his railway engineering work in 1886 for the Southern Pacific Co. From 1890-1900 he served as axeman, chainman, rodman, timekeeper, material clerk, inspector, and instrumentman with the Southern Pacific, and during the following three years as officeman and assistant engineer with the Texas & New Orleans R.R. and the Southern Pacific Terminal Co. of Texas. From 1903-1906 he served as assistant engineer with several of the Southern Pacific subsidiaries and then became engineer of construction for the Pacific Engineering Co. He entered the service of the Oregon-Washington Railroad & Navigation Co. in 1905 and in 1913 resigned as assistant general manager to become chief engineer. He was later appointed assistant chief engineer of the Southern Pacific Co., Pacific System.

ALDRICH DURANT, formerly of the board of governors of the Associated Pennsylvania Highway Contractors, has gone to Peru in connection with extensive port development work for which the Foundation Co. of New York holds the contract.

H. A. VON SCHON, consulting engineer, recently of Washington, D. C., has accepted appointment of court commissioner to regulate water power operations on the St. Joseph River, with office at South Bend, Ind. He will continue his consulting practice in hydroelectric engineering, public utility valuations, underwriters reports, water rights and public service legal issues.

BERNARD C. HARVEY has been appointed city engineer of Rockford, Ill.

WILLIAM L. ROCKWELL, consulting engineer for thirty years in hydraulic engineering, including irrigation development, water supply and power development, has just returned from two years in the West Indies, and has resumed his consulting hydraulic engineering practice at Austin, Tex.

L. L. BATEMEN, formerly resident engineer for the Michigan State Highway Department, in charge of trunk line construction in Cheboygan and Otsego Counties, has been appointed assistant county engineer of Huron County, Mich.

GEORGE F. CATLETT, formerly sanitary engineer for the Consolidated Board of Health of New Hanover County in Wilmington, N. C., has been appointed principal assistant engineer Bureau of Engineering, North Carolina State Board of Health, and in this capacity will have charge of the water supply division of this bureau.

CHESTER H. LOVELAND, chief hydraulic engineer of the California Railroad Commission, has resigned to enter private practice as consulting engineer to participate in the development of the state's water resources. He has been with the commission for seven years, and during that time has been active in matters relating to domestic water and irrigation projects throughout the state. During the water shortage of last year, it was largely through his efforts that the "Emergency Water Conference" formed of state and federal officials, was organized.

A. G. MOTT, for nearly twelve years connected with the Southern Pacific Co., has resigned as assistant engineer to accept a similar position with the California Railroad Commission, San Francisco.

W. V. TAYLOR of Gananoque, Ont., has been appointed city engineer of Sarnia, Ont.

D. S. MCCALMAN has resigned as state highway superintendent of Wyoming.

FRANK P. SCHADE has been appointed city engineer of Cudahy, Wis.

A. C. BRADLEY, recently division engineer Chicago, Rock Island & Pacific Ry., with headquarters at Colorado Springs, Col., has been transferred to the Chicago Terminal division, with headquarters at Chicago.

THEODORE LANCTOT, who has been assistant engineer in the public works department, and superintendent of the Canadian Highway's Engineering Co., Ltd., Montreal, has been appointed city engineer of Hull, Que.

CARLOS E. ELLERBROOK, formerly highway engineer and inspector, Michigan State Highway Department, is now with the Iowa State Highway Commission as highway engineer and will have charge of a 17-mile paving project starting from Sioux City.

EDWARD G. ELLIOTT, formerly with the Illinois State Highway Commission and with the New York State Highway Commission, is now county road engineer, Randolph County, W. Va.

S. R. BATSON has resigned as county engineer of Jefferson County, Ala., to enter private engineering practice.

C. J. ROGERS, formerly assistant county engineer, Jefferson County, Ala., has been appointed county engineer.

WILLIAM H. HULL, for many years associated with the T. A. Scott Co., Inc., New London, Conn., and Boston, Mass., in their engineering department, has been elected vice-president in charge of engineering and construction.

HOWARD M. RAYMOND, dean of engineering, Armour Institute, since 1903, and connected with the institute for twenty-six years, has been made acting president to fill the vacancy caused by the recent death of Dr. F. W. Gunsaulus.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Federal Reserve Banks Report Increases in Building

In analyzing the reports of its member banks, the Federal Reserve Board, in discussing conditions as of May 1, has the following to say of interest to the building industry: "Building operations showed increased activity during March, which is a normal condition for this season of the year. Number of building permits, value of building permits, and value of contracts awarded all registered marked increases as compared with February. This increase is particularly large in the case of number of permits, as a result of the continued increase in the building of residences. Contracts awarded in the New England states amounted to $13,262,000 during March, an increase of 84 per cent over February."

Following are the reports from districts:

District No. 2 (New York)—Contracts amounting to $29,846,000, an increase of 40 per cent over the February figure, of which 59 per cent were for residential buildings, as compared with 48 per cent in February and 40 per cent in January. The increase in residential construction has been confined almost entirely to the least expensive apartments and small homes.

District No. 3 (Philadelphia)—Large increase in the value of building permits issued during March in comparison with the February. Funds for mortgages have been difficult to obtain, but there has been a steady increase in number of houses bought through the building and loan associations.

District No. 4 (Cleveland)—An increase in value of building permits issued during March, but there still seems to be a tendency to wait for lower costs before commencing construction.

District No. 5 (Richmond)—Reports from 23 cities show 1,718 permits issued for new construction during March, in comparison with 894 permits issued in February. This number was greater than that for any month since February, 1920.

District No. 6 (Atlanta)—Value of permits increased about 50 per cent for March in comparison with February figures. Noteworthy increases in activity occurred in Atlanta, Birmingham and Tampa.

District No. 7 (Chicago)—There was an increase in value both for building permits and contracts awarded during March, as compared with February figures.

District No. 8 (St. Louis)—Increase noted in value of building permits for three leading cities in March, as compared with February, but these figures are very much below those for March, 1920.

District No. 9 (Minneapolis)—Permits valued at $2,647,666 were issued in the reporting centers in March, as compared with a value of $2,179,784 in February. This increase is due to a substantial gain in the number of permits issued for repairs and alterations.

District No. 10 (Kansas City)—Seventeen cities issued 2,778 contracts in March, an increase of about 100 per cent over the February figure and an increase of about 18 per cent over the total of March, 1920.

District No. 11 (Dallas)—Both the number and value of building permits issued in March was the largest monthly total since October, 1920.

District No. 12 (San Francisco)—The value of permits for 20 cities amounted to $18,542,835, an increase of 57 per cent over February, 1921, and 27 per cent over March, 1920. Number of permits in those cities increased 47 per cent over February, 1921, and 38 per cent over March, 1920. Declining prices of building materials and some reduction in labor costs have reduced the number of factors which have been retarding building operations.

Wholesale Costs—Construction and Living

General Construction Costs Compared with Wholesale Prices of All Commodities and Special Groups

The relation between general wholesale prices and the basic cost of construction in the United States is indicated by Fig. 1, in which the well-known index numbers of R. G. Dun and of the United States Bureau of Labor Statistics are plotted with a construction-cost estimation compiled by *Engineering News-Record*. The Labor Bureau figures were already on the basis of 100 for the year 1913, and Dun's figures and *Engineering News-Record's* have been made to agree with this same basis. *Engineering News-Record's* figures and those of the Labor Bureau are yearly averages, whereas the two Dun curves show conditions in January and July, respectively, of each year. The agreement of the four curves is close, except as regards the decline in 1921. General wholesale prices have fallen sharply, while construction cost is lowering conservatively, as happened after the Civil War.

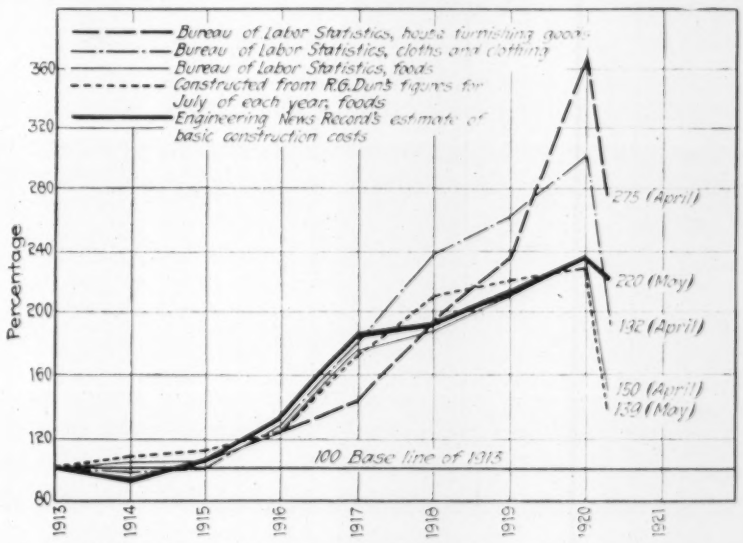


FIG. 1—RELATION OF GENERAL WHOLESALE PRICES AND CONSTRUCTION COSTS

Intelligent study of the chart necessitates a knowledge of what each of the curves means. The "All Commodities Index Number" of the Bureau of Labor Statistics is the summation of nine classes: Farm products, food, cloths and clothing, fuel and lighting, metals and metal products, building materials, chemicals and drugs, house furnishing goods, and miscellaneous. Dun's Index Number is the total of seven classifications: Breadstuffs, including quotations on wheat, corn, oats, rye, barley, beans and peas; meat; dairy and garden, including butter, eggs, vegetables and fruits; fish, condiments, sugar, rice and tobacco; clothing; metals; and miscellaneous, embracing lumber, lath, brick, lime, glass, turpentine, hemp, linseed oil, paints, fertilizers and drugs.

Engineering News-Record's figures take into consideration the rate paid common labor, and the price movement of the three construction materials least influenced by local conditions: steel, lumber and cement. The base prices of structural shapes at Pittsburgh, Southern pine (3 x 12 to 12 x 12) in New York, cement (without bags) f.o.b. Chicago, and the daily wage of common labor, were carefully weighted according to their relative importance and then combined so as to give 100 as the 1913 estimation of construction cost. The percentages for the ensuing years are as follows:

1914	94
1915	106
1916	135
1917	181
1918	192
1919	210
1920	237
1921 (four months)	220

It is seen that construction cost fell in 1914, while general wholesale prices either hung fire—according to the Labor Bureau figures—or advanced, as shown by Dun's calculations. It is interesting, that when the European War broke, the uncertainty consequent to surprise caused metals, the pre-eminent war materials, to decline. Between

the spring of 1913 and 1914 structural shapes, Pittsburgh mill, fell from $1.62 to $1.13, reinforcing bars at Pittsburgh mill from $1.50 to $1.17, Dun shows that metals dropped from $16.512 to $15.691.

Fig. 2 shows construction cost compared with the wholesale prices of food, clothing and house-furnishing goods. The Dun food curve was constructed by reducing the index numbers for breadstuffs, meat, dairy and garden products, etc., to a 100 per cent basis for 1913, and then averaging them.

Since 1920, prices of both raw materials and manufactured products, and in many sections the rates paid labor, have fallen more or less sharply. Construction materials have lagged behind living necessities, as is to be expected of materials whose output can be limited to the demand. There is

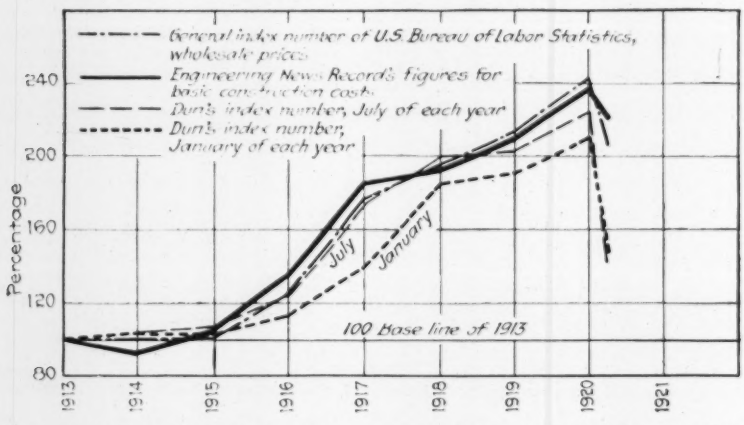


FIG. 2—COMPARISON OF CONSTRUCTION COST AND WHOLESALE PRICES OF FOOD, CLOTHING AND HOUSE-FURNISHING GOODS

only a slight control over the production of food products, and output is chiefly dependent upon the abundance or scarcity of crops and live stock. House furnishings soared to a prohibitive peak and are now descending rapidly. In fact, the wholesale prices of foods, clothing and house furnishing goods appear to be declining at about the same rate, with construction materials following at a more conservative pace.

New York Lets Highway Contract Worth $2,900,000

Contracts for the construction and repair of highways were let during the past week by the New York Highway Commission aggregating in excess of $2,900,000. Bids for the construction and repair of these roads were received on May 3 and 4, 110 miles of new highways being involved. Of these 110 miles distributed among 21 projects in practically as many counties, the total estimate was $4,269,679, whereas the sum of the low bids was $3,905,167, a saving of $364,512.

There was an average of five bidders for each project, one project attracting twelve bidders and another eleven.

Conditions in the Common Brick Industry

As indicating the trend in the price of common brick, a composite price taken from the reports of 142 members of the Common Brick Manufacturers' Association on Feb. 1, gave $18.05 as the per-thousand price. From the reports of 132 members on March 1, the price was $17.40, and the composite price of current reports from 126 members reduces the figure to $16.97 per thousand, according to a recent digest of the association. The actual range is from $12 to $25 throughout the country. The lowest price quoted is that of Chicago.

The general condition of the industry is shown by the fact that current reports show only 84 plants closed, whereas a previous monthly report showed 115. The quantity of burned brick on hand has in thirty days been reduced from 331,940,000 to 264,697,000, and orders during the month have increased from 111,182,000 to 114,875,000. Of the plants reporting as being closed, about one-fifth have so adjusted their stock that they plan early resumption of operation. The digest predicts much greater activity in the brick industry during the coming month.

Southern Pine Orders Reach New High Mark

During the week ended April 29 orders received by members of the Southern Pine Association averaged 20 per cent more per mill than ever reported for the corresponding week of other years, according to a recent bulletin issued by the association. Orders represented an average of 694,049 ft.b.m. per mill, the next figure to this being in 1919 when orders for 576,409 ft.b.m. were received.

This high figure is also a larger amount than has been received in any other week in 1921, being nearly 50 per cent in excess of orders reported during the last week of March.

Drive On To Lower Freight Rates

Railway executives, Interstate Commerce Commission members, and producers and shippers of building materials are to meet in Washington tomorrow in conference to discuss the proposition of lower freight rates on building material. The meeting was arranged after representatives of the principal material producers on May 3 conferred with Chariman Winslow of the House Interstate Commerce Committee, with Chairman Clark of the Interstate Commerce Commission, and later with President Harding. At that time it was suggested a joint conference be arranged, the meeting tomorrow being the result. Material producers generally feel that construction stagnation is due in a large extent to high freight rates on building material. Organizations represented at the meeting May 3, and which will probably be represented at tomorrow's conference, include the National Association of Sand and Gravel Producers, National Paving Brick Manufacturers Association, American Face Brick Association, Hollow Building Tile Association, National Lumber Manufacturers Association, National Crushed Stone Association and the Gypsum Industries Association.

Bond Decisions Slow Up Street Work in Columbus

Two recent decisions of bond houses changing the method of disposing of municipal bonds in Ohio have resulted in delays in the Columbus street-improvement program. The first of the decisions declares illegal the practice of sinking-fund trustees selling bonds for other than sinking-fund purposes. This prevents the sale of bonds in order to buy other bonds, thereby changing the usual method of having the sinking fund immediately absorb street improvement bond issues. The other decision advised against the purchase of bonds for street, alley and sewer improvements until the assessments on property owners had actually been made. The former procedure had been to authorize bonds and sell them in anticipation of the assessments and then go ahead with the work.

Ontario To Build Cement Plant

The Ontario, Canada, Legislature has appropriated $1,000,000 to provide for the construction of a provincial cement plan. According to the present plan the plant will have a capacity of 300,000 bbl. per year, the ouptput from the plant to be used for supplying cement to municipal and provincial construction work. During the past year the province has had to cancel important contracts owing to its inability to secure cement except at excessive prices. The government has no intention of competing in the open market with private concerns, its intention being to furnish a source of supply for municipal and provincial contracts.

Jail Term Asked for Building Material Dealers

Special Deputy Attorney General W. A. DeFord has urged that Justice Davis of the Supreme Court impose jail sentences upon the nineteen individuals, and heavy fines upon the thirteen corporations, members of the Association of Dealers in Masons' Building Materials, New York City, who pleaded guilty to conspiracy and violations of the Donnelly anti-trust law, following disclosures made before the Lockwood joint legislative committee on housing. Justice Davis, however, deferred imposition of sentence until he can more fully determine how culpable the defendants are, and how able to pay maximum fines. Sentence will be imposed before the trial of the eighteen other defendants in the case begins, which is scheduled for an early date.

Northwest Lumber Production Increases

Lumber production among the 112 mills reporting to the West Coast Lumbermen's Association increased four per cent during the week ended April 30, the output at that date being 29 per cent under normal. Total production amounted to 57,719,880 ft.b.m., and new business 63,287,331 ft.b.m. For the four months ended April 30 the production was but 47 per cent of that for the same period of 1920, says the association's bulletin.

Southern Pine Production 80 Per Cent of Normal

According to the Southern Pine Association's statistical statement for the month of March, 1921, 195 mills reported the production 79.39 per cent of normal. Orders for the month for 142 mills reporting were 79.38 per cent of normal, and shipments for the month, 79.86 per cent of normal. The stocks on hand March 31 were 101.98 per cent of normal. The March cut of the 195 mills was 387,958,529 ft. b.m.

Building Activity in Los Angeles Still at High Level

Building permits were issued in Los Angeles during the month of April for 2,904 structures estimated to cost a total of $7,250,511. This surpasses in value the highest previous record in the history of the city, which was made in September, 1920, with buildings valued at $7,231,000. In March, 1921, permits were issued for structures with a total cost of $6,915,698.

The present activity is chiefly in commercial and industrial buildings, a large percentage ranging from 50,000 to $100,000 in value. In the number and value of dwellings started as compared with September last, the month of April showed a decrease, falling under the September figure by about $750,000 in value and between 300 and 400 in the number of permits.

Providence Dam Contract Let

The water supply board of Providence, R. I., has let the contract for the construction of the main dam and dike at the Scituate reservoir, to Winston & Co., 240 Fair St., Kingston, N. Y. The successful bid was $3,499,925. Bids for the construction of the dam and dike were opened on April 27, seven contractors submitting bids, the highest bidder being in excess of $6,000,000.

Construction Articles in This Issue

Bunkhouses Built in Sections For Convenience in Moving Page 800
New Concrete Arch Survives Washout of Centers Page 809
Levee Settlement Causes Seepage Under Pump House Page 814
Tunnel Building in Nicaraguan Jungles Page 821
Germany Returns to Adobe Building Page 823

Large Foreign Locomotive Order

The American Locomotive Co. has obtained an order for 42 locomotives of the Pacific, Mikado and Mallet types for the Pekin Kalgan Ry. of China. The total value of the contract is in the neighborhood of $2,600,000. The Pekin Kalgan Ry. is owned by the Chinese Government and the payment for these locomotives is financed jointly by the American Locomotive Co. and Mitsui & Co.

Slight Increase in Car Loadings for Week Ending April 23

Reports just received from the railroads of the country by the car service division of the American Railway Association showed another slight increase in the number of cars loaded with revenue freight during the week which ended on April 23. The total for the week was 704,527 which was an increase of 631 cars over that for the previous week. It was, however, a decrease of 13,000 compared with the corresponding week in 1920 and 10,500 compared with the corresponding week in 1919.

Compared with the preceding week, increases were reported in the loading of coal, coke, ore and live stock while there were decreases in the number of cars loaded with grain and grain products, forest products and merchandise and miscellaneous freight which includes manufactured products. Coal loading totaled 138,576 cars which was an increase over the previous week of 2,900 cars. It was, however, a decrease of 17,000 cars compared with the corresponding week in 1920 and 700 compared with the corresponding week in 1919. Loading of merchandise and miscellaneous freight totaled for the week 446,637 cars, which was a decrease of 4,489 cars over the previous week.

Semi-Monthly Estimates for Ohio Road Contractors

The Ohio Highway Commission has worked out a plan whereby contractors doing state work will be able to receive their money at least once a month and if the amount is high, two times monthly. One of the chief difficulties met by contractors has been the getting of estimates through and vouchers drawn. Now, vouchers are sent out the tenth of the month for all work done up to the first of the month and if the amount done by the fifteenth of the month is $5,000 or more, another voucher will be mailed out on the twenty-fifth of the month, covering such work. The new plan is receiving much praise from contractors engaged on highway work.

Three Large Contracts Included in Record Total of $35,000,000

Due to the letting of three contracts during the week each calling for the expenditure of $3,000,000 or more, the past week eclipsed all previous weeks for the year in contracts let, as reported in *Engineering News-Record* The total for the week was $35,749,872, of which miscellaneous building represented $17,058,847, and streets and roads $9,652,345.

The three large contracts let were for the Providence dam, noted elsewhere in this issue, and two $3,000,000 buildings in New York City, one an office building, of twenty-three stories and the other a structure to be erected for the Society for the Prevention of Cruelty to Children.

Pennsylvania and Ohio together let road contracts valued at $4,445,808. Ohio is to receive bids for the construction of over forty projects May 27.

Strikes Follow Proposed Cuts in Building Trade Wages

Strikes have been precipitated in many cities due to the proposed reduction of building trade labor, which varies form 10 to 25 per cent. As a protest against a 24 per cent reduction in Philadelphia between 40,000 and 65,000 men have struck, employers reporting the former number out and the building trades council naming the latter figure. In Cleveland between 25,000 and 30,000 men employed on projects operated by contractors affiliated with the building trades employers' association struck May 2, after reporting for work. Union leaders demand a continuation of the wage scale which came to a close on May 1 and employers are insisting upon a general 20 per cent reduction. Labor leaders in Cleveland are not despairing of securing separate agreements with employers on the old basis.

In Newark, N. J., practically all trades struck on May 2, the jobs struck being those carried on by members of the Building Trades Employers Association. According to union agents,

most of the men in the trades have lined up with independent contractors who, it is reported, are willing to continue the old scale. The situation in Boston remains practically the same, the building trades employers in that city having several weeks ago announced an open shop policy due to the fact that the opposing factions were unable to come to any sort of an agreement upon wages.

In Kansas City some progress has been made toward arbitrating the differences between building trade labor and employers. However, not all of the trades in St. Louis are willing to arbitrate the question, the following being among those willing to abritrate: Carpenters, building laborers, hod carriers, engineers, iron workers, lathers and cement finishers. In upstate New York strikes are reported from various localities, the worst trouble being experienced in Albany.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of May 5, the next, on June 2.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$3.33	$4.00	$3.75	$3.23	$3.51	$4.65	$4.35	$5.00	$5.00
Structural rivets, 100 lb	4.85	5.25	7.05	4.88	5.30	6.25	7.05	6.25	8.50
Reinforcing bars, ¾ in. and larger, 100 lb	3.23	3.25	3.85	3.13	3.53½	4.32½	2.35	4.50	4.25
Steel pipe, black, 3½ to 6 in. lap, discount	49%	50 65–5%	45%	58½%	51 9–5%	29%	49.80	45%	5%
Cast-iron pipe, 6 in. and over, ton	63.30	59.22	66.20	64.10	67.80	70.00	85.90	72.00	75.00
Concreting Material:									
Cement without bags, bbl	2.90 (del.)	3.00	2.85	2.17	2.41	3.10	3.09	3.10	3.44
Gravel, ¾ in., cu.yd	2.50	2.80	1.75	2.75	2.00	2.50	2.25	1.50	1.50
Sand, cu.yd	1.25	1.62½	1.75	2.75	1.00	1.10	1.65	1.50	1.25
Crushed stone, ¾ in., cu.yd	2.15	2.50	3.20	2.75	2.25	3.50	2.25	3.50	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	48.00	38.00	45.00	55.00	38.00	47.00	27.00	24.00	120.00
Lime, finished, hydrated, ton	21.00	22.50	25.00	20.00	29.00	32.00	25.40	24.00	30.00
Lime common, lump, 200 lb. bbl	3.30	1.60	2.50	1.65	2.00	3.20	2.25	2.75	15.00
Common brick, delivered, 1,000	18.40	12.50	25.00	12.00	18.00	14.00	18.00	16.00	18.00
Hollow building tile, 4x12x12, block	Not used	.14	.21	.12	.10	.09	.12½	.11	.19
Hollow partition tile 4x12x12, block	....	.15	.19½	.09½	.10	.10	.16	.12	.....
Linseed oil, raw, 5 bbl. lots, gal	.70	.67	.88	.82	.83	.90	.92	.79	.72
Common Labor:									
Common labor, union, hour	.75@.80	.35	.60@1.00	1.00	.50	.50@.63½	.81¼	.75	.....
Common labor, non-union, hour	.....	.25	.40@.60	.50	.50	.37½@.50	.50@.55	.40@.45	.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 *and* 5 per cent, 45@50 means a range of 45 *to* 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Sand, gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. paper bags. **Minneapolis** quotes on fir instead of pine. Brick is $18 delivered, $16 on cars. Gravel, sand and crushed stone quoted at pit. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of per cu.yd. **Dallas** quotes lime by the 180-lb. bbl. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir instead of pine; and on lime in paper bags. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; steel and pipe at warehouse. No organized common labor in Montreal.

Changes Since Last Week

The adjustment of steel prices at warehouses, to agree with the recent reduction by the United States Steel Corporation, is now practically complete. Latest information quotes rivets at $6.25 in Denver, against the former price of $6.90 per 100 lb., while structural shapes are down 10c. per 100 lb. in San Francisco. Wrought pipe in Seattle is five points cheaper. Cast-iron pipe is down $1 per ton in Seattle, and $5 off in Montreal, being most expensive in San Francisco, where the price is $85.90. The Seattle quotation is $72; Montreal, $75.

Atlanta reports that prices in that city are not stable, owing to a "price fight" between dealers. We show lime and sand in Atlanta apparently higher than on Apr. 28, but the 10 per cent discount for cash makes up for the difference. Finished hydrated lime sells for $22.50 per ton, common hydrated for $18.

Common brick in Minneapolis is still quoted at $18 per 1000, although a large dealer reports that clay brick may be bought for $17. Fire brick dropped $5 last week. Cement costs $2.60 net delivered, $2.41 f.o.b. city.

For several weeks we have been calling attention to the steady decline in the price of linseed oil. Apparently the bottom has been reached. Five of our nine cities report a stronger market and higher prices.

New York quotations are practically the same as they were two weeks ago, although there is an interesting situation that renders sand and gravel attractive materials for immediate purchase. The formal price of gravel is still $2.50 per cu.yd., but it is reported that gravel can be had for as low as $2.

As regards labor — Minneapolis reports that the situation in that city is a case of "bluffing" on the part of both employers and unions. The reduced scale covering all the building crafts was effective May 1, but none of the unions has officially accepted the new scale, and the painters are on strike. Employers assert that sufficient non-union men are available and that many union men are employed at the new rates. Chicago reports: "On account of strike, everything is dead." A telegram from San Francisco states that the board selected by contractors and unions has decided that 17 crafts be reduced 7½ per cent instead of being granted the increase asked. The unions have rejected the finding, and the contractors assert that on May 9 they will put the board's scale into effect. Denver reports a slight increase in employment.